

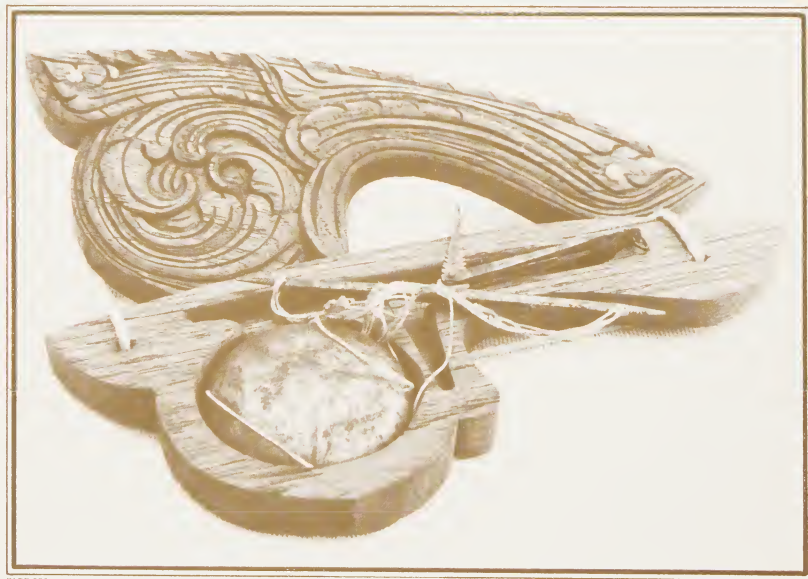


EQUILIBRIUM

QUARTERLY MAGAZINE OF THE INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

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PAGE 625

Cover Picture

DIANA CRAWFORTH

This gold scale was made on the Malay Penninsular and shows all the characteristics of that area. The box is shaped like a snail sliding along with its shell on its back. It is cut from one piece of red wood split horizontally and carved elegantly on the lid. The two parts are held together by two knotted cords, simply and effectively.

The scale beam is made of a hard bronze/brass, decoratively scored at the end to give notched edges like a leaf. The pointer is triangular and also decoratively notched, with the centre pivot drilled through it, well above the centre of gravity, giving excessive stability and insensitivity. The shears, too, have notched decoration, with a much larger area of brass above the pointer than would be normal in Europe. The beam ends have no knife edges, but would originally have had little brass rings put through the holes onto which the cords would have been fastened. The deeply rounded pans are of heavy gauge bronze/brass, but no weights were kept in the box.

The features mentioned are all common to Indian Ocean scales, and variations are minor. The shell on the snail is in the centre of its body towards the Western side of the Ocean and the box held shut by two little cord rings. On the Malay Penninsular, lacquer paste was frequently added to the box to give a glossy terra-cotta, red, maroon or dark brown finish. There were variations in the amount of carving cut into the lid, some were plain, others very elaborate - this example is about average. The box was made of sheet brass around Bahrain, and the lid was hinged at the end and retained by a swinging brass loop at the other end. Examples from the South-West of the Ocean show greater stylistic variation with different beam end shapes and a cord in place of shears. These similarities are possibly due to the Arab traders taking their dhows around the 9,000 mile coastline, and using this type of scale at every port of call.

INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

Founded September, 1976

20 North Wacker Drive • Chicago, IL 60606 • U.S.A.

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A Rare Wilkinson Balance

LOU UIT DEN BOOGAARD

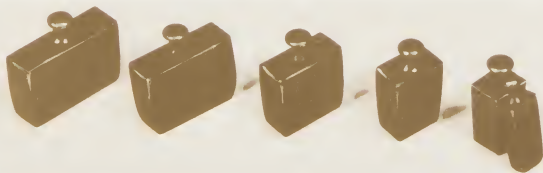


Our members will remember last year's scale auction in Essen, Germany. One day later there was an antique fair and our member Jaap Visser bought there this special Wilkinson coin scale. Strange that it came from Denmark to be sold in Germany, but was made nearly 200 years ago in England.

Let me start with a short historical background of Anthony Wilkinson*. He was born in about 1732, and was assessed for Land Tax, living in Kirkby, from 1781 to 1785, and in Ormskirk from 1786 until his death in 1801. His name appeared in jury lists as a 'Gold balance maker' in 1792, '97 and '98. He had two well-known tenants living in his cottages, Stephen Houghton and Daniel Robinson, who were probably his journeymen, and who later made balances in their own names.

Wilkinson claimed to be the inventor of the folding gold balance, and he normally made two types, one with a turn-over weight fixed to the beam, and one with a pan and coin plate and, at the end of the box, two round knobbed weights for the guinea and half guinea, marked 5.8 and 2.16. From Fig 1, you can see that this special scale has a pan and plate, but the other details are very different. Weights are stored at both sides of the box. They are rectangular with knobs, and the larger ones are marked 6, 5 and 4. The three smaller ones are unmarked. The measured mass of these weights is:

6 pennyweights	=	9.2 grams	marked 6.	3 pennyweights	=	4.7 grams
5 "	=	7.7 "	" 5	2 "	=	3.15 "
4 "	=	6.15 "	" 4	1 "	=	1.6 "



* Taken from 'Weighing Coins - English Folding Gold Balances of the 18th and 19th Centuries' by Michael A.Crawforth.



There are two paper labels: In the box -

*To prevent imposition, A. Wilkinson of Ormskirk
the Original inventor of these PATENT Gold
balances, writes his Name with his own hand.*

*Sold by Henry Bell,
Lancaster.*

In the lid - (line ends are shown as /).

*DIRECTIONS: The scale on the other side of the Standard for dwts.- for an
equal balance leave / the slide upon the other end of the beam at the centre,
and bring the slide on this end to the stop: / This slide when moved to the
centre is 12 grains, and the other slide stops at every grain./ Both slides
at the centre when you shut up the box, with the scale on this side at the
top of the / beam and of the other side below it.*

It would be of great interest to know if any member has seen a similar balance in a museum or private collection.

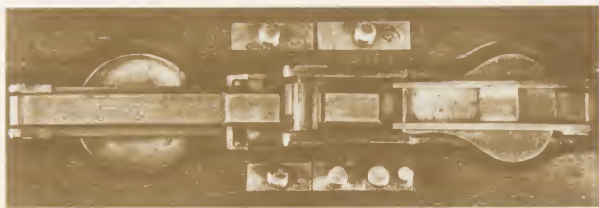
EDITOR'S NOTE:

This very rare Wilkinson balance was to weigh virtually any gold coin which might be encountered by the international merchant or traveller. It had the advantages of compactness, speed of use, and a minimum of weights to carry. Also, there were no small grain weights to handle or to be lost. However, the user had to know the correct weight of the coins he wished to test. The balance was used in the following way:-

Start with the beam equally balanced, with the left slide at the centre and the right slide at the end of the beam. Place pennyweights in the pan on the left. Set the slide on the left to the required number of grains. Test the coin by placing it on the coin plate.

The capacity of the left slide is 0 - 12 grains, so if the required number of grains is higher than 12, move the right slide to the centre. This adds 12 grains. Then re-set the left slide to make up the additional grains. i.e. for 18 grains, move the right slide to the centre and set the left slide to 6, to make a total of 18 grains.

If the coin is underweight, the left slide is moved towards the centre until the beam balances. Determine the grains underweight by subtracting the measured setting from the required setting, on the beam.



Scales & Weights

Several superb illustrations from the 18th century encyclopaedia by Diderot and D'Alembert have already been published in *Equilibrium*, on pages 468 - 476. They appeared in the encyclopaedia under the heading "Balancier" (Scalemaker). Two further plates are shown under the heading "Chymie" (Chemistry), also published in 1763. They show details of balances and weights used for assay purposes.

The Editor is indebted to YVES NOËL for supplying the illustrations and for help with translation and biographical information. Comments by MICHAEL CRAWFORTH.

PLATE XV CHEMISTRY

FIG 246. Nut for fixing the balance suspension bracket to the glass case.

FIG 247. Assay balance in a glass case made by Galonde for Rouelle. It looks as if the balance is raised for weighing by sliding the disc towards the operator, and the central spring button and toothed rack permit the mechanism to be locked in any desired position.

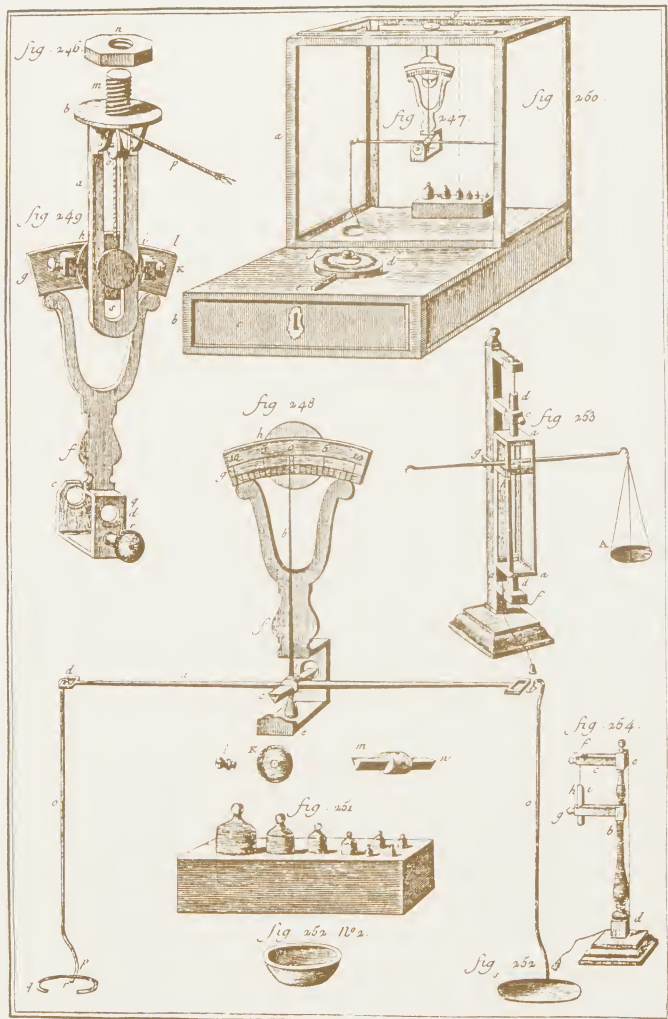
- FIG 248. Details of the balance showing the triangular knife-edge with the counterweight for the pointer beneath it; the graduated arc; and the rod hangers suspended from unusual beam ends. It may be assumed that the beam ends were filed to a knife edge, and were not flat, as shown by the artist.
- FIG 249. The cord is shown pulling the suspension block up the slot. The beam suspender swings freely between two screw-pivots and is adjusted for horizontality of the bearings by the screw (r) projecting from the bottom.
- FIG 250. The glass case appears to have a slide-up front and a very long drawer.
- FIG 251. Assay weights stored in a wood block.
- FIG 252. Glass basin for weighing liquids.
- FIG 253. Cramer's second balance. This design has a down-facing pointer and conventional swan-neck beam ends. Is the narrow box a form of arrestment for the beam, combined with a protection for the pointer ?
- FIG 254. Stand for Cramer's first balance showing the cord and pulley wheel system. (The balance is shown in Plate XV bis).

PLATE XV bis CHEMISTRY

- FIG 255. Beam of Cramer's first balance showing the swan-neck ends and the decoratively pierced pointer.
- FIG 256. Shears for the balance, with decorated sight-hole and feet.
- FIG 257. The pendant used to hold the shear legs at the correct spacing, (shown upside down).
- FIG 258. Pans and cords.

These plates depict the early use of several interesting features; the locking slide on the cord lifting system; the mechanism for levelling the bearings; the downward pointer, and, what was claimed as a new invention, the rod hangers. These rods replaced the traditional silk cords which caused errors in fine weighing due to the absorption of moisture from the air. These features, combined with the glass case, probably brought the old style of balance to its peak performance. The great break-through in weighing sensitivity and accuracy came some years later with the invention of light rigid beams, continuous knife-edges, and plane bearings.

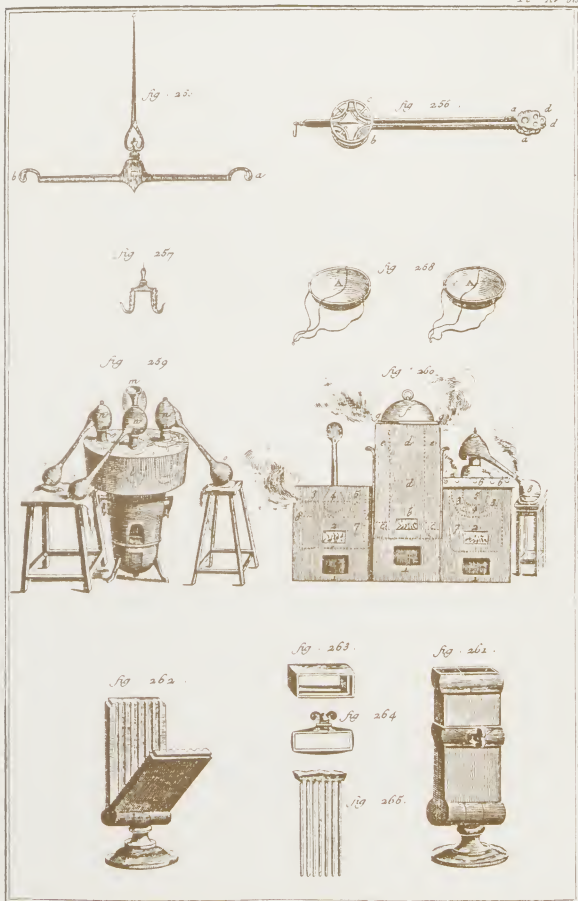
The men mentioned in the captions were; J.A.Cramer (1710 - 1777), a German who published, in 1739, his treatise 'Elementa Artis Docimasticae' (Elements in the Art of Assaying); G.F.Rouelle (1703 - 1770), who was a well-known French chemist; and Galonde, who was a Paris clockmaker about whom Villiers wrote in the encyclopaedia "The assay balance which we will be talking about, has not been described anywhere... It is to Monsieur Galonde that we owe its state of perfection. This ingenious maker is known in Paris for the skill with which he makes clocks and other mechanisms..."



Goussier del.

Amard fecit.

Chymic.



Chymie.

Benard, Esc.

Iron Weights in Britain Part 3

MICHAEL CRAWFORTH



In the last part of this article, I shall deal with reader's queries arising from parts 1 and 2. Firstly, some surprise has been expressed at the use of metric weights in Britain, long before official metrication. The use of metric weights for trade purposes was permitted by the Weights and Measures Act of 1897, but these weights were made (and perhaps used) in Britain before that date. The earliest catalogue I have found, which lists metric weights, is dated 1880. Before that, most adverts I have seen offer weights made to ANY desired foreign weight system, but they do not specify metric weights in particular. Earlier catalogues listing metric weights may exist.

Iron metric weights were used in Britain in laboratories and factories where the *scientific* use of the metric system was in advance of our recent change to the *commercial* use of the metric system. Also, they were used for selling goods, by weight, to countries where the metric system was in use. Metric weights were made for export, and a few, of course, were used as standards by scale and weight makers. The Weights and Measures Act of 1889 made provision for Inspectors to verify metric weights using standards supplied by the Board of Trade.

Secondly, several members have asked about the treatment of rust and the subsequent protection of iron weights. Removal and neutralisation of rust was dealt with in Notes & Queries (p 219 & 280). Of the methods mentioned, I recommend the use of a steel wire brush followed by painstakingly scratching with a pin, or other pointed tool, to remove rust from letters and numbers. Patience is usually well rewarded by the great increase in

FIG 51. (above) A set of iron bell weights, 14,7,4,2,1 lb and 8,4 oz. This style, with the narrow necked handle, and the stepped base, was shown in the 1906 catalogue of W. & T. Avery Ltd. Lead plugs underneath stamped crown GR 71, G, 47. (Newcastle on Tyne, 1947).

clarity and definition of the letters. After cleaning, the remaining rust is neutralised by painting with a "rust killer" of the type sold for motor cars. This is based on phosphoric acid, and typical trade names are Naval Jelly, and Jenolite.

For protection and appearance, the quickest method is to brush on an old-fashioned black graphite stove polish, using an old toothbrush. Leave the polish to dry for ten minutes and then polish it with a soft cloth. This treatment was officially approved by the Board of Trade. It has the disadvantage that a little black polish may come off onto your hands when handling the weights. A very durable and good-looking finish can be obtained by painting the cleaned weights with matt black paint and, when that is dry, painting again with a satin finish clear polyurathane varnish. Another good finish can be obtained using matt black paint polished with black or brown shoe polish. N.B. ALWAYS neutralise the rust, and apply paint THINLY.

Finally, queries about the dates of makers of iron weights may be answered by the list on page 638. This list shows the dates known, so far, for those makers or retailers whose names have been seen on iron weights. If you have iron weights with names not shown on this list, please let me know.

NOTES ON THE ILLUSTRATIONS

- FIG 52. "CRANE FOUNDRY CO. WOLVERHAMPTON 1 lb" also $\frac{1}{2}$ lb and $\frac{1}{4}$ lb. "CRANE FOUNDRY CO. 2 oz" also 1 oz. Lead plug on top of largest weight, indicating a date before 1907. No stamps. Cross-section A in drawing 1, page 583.
- FIG 53. "J.& J.W. 8 oz" Lead plug underneath, stamp obliterated. The initials are those of Jabez and John Whitehouse.
- FIG 54. "FALKIRK IRON COY. $\frac{1}{4}$ lb" Lead plug underneath stamped crown GR 594 (Falkirk). The ring cast above the ' $\frac{1}{4}$ lb' for a lead plug, suggests the continued use of a 19th century design, so the weight was probably made soon after the 1907 Regulations.
- FIG 55. "IMPERIAL STANDARD $\frac{1}{4}$ lb" Three adjustment holes underneath, copper plug on top, stamp obliterated. Pre 1907.
- FIG 56 & 57. A set of proportional weights from a person scale for weighing schoolchildren, by W.& T.Avery Ltd. The slots fit on the chrome-plated hanger. "3 lb = 3 stone" "2 lb = 2 stone" and three weights marked "1 lb = 1 stone". The weights are specially shaped to form a truncated cone when all of them are on the hanger. So the three 1 lb weights are all different sizes ! The values show the steelyard had a lever ratio of 14 : 1.
- FIG 58. "2 lb. L.M." Lead plug on top and underneath, stamps obliterated. Made before 1907. L.M. is unidentified, so far.
- FIG 59. "4 lb" "2 lb" Lead plugs on top, stamp obliterated. Adjustment holes underneath. Although the 'lb' is cast in, it appears to have been added to the mould sometime after the initial design, which suggests that the design was initiated before 1864.

FIG 52.



FIG 53.

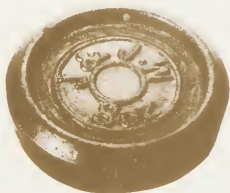


FIG 56.



FIG 54.



FIG 55.

FIG 57.



- FIG 60. "4 oz" This small 'brick weight' has a lead plug underneath, stamped crown GR 270 (West Bromwich).
- FIG 61. "2 lb" A slotted weight from a kitchen scale, c1935.
- FIG 62. "HOLCROFT 4 LB" A brick weight with a rectangular lead plug underneath, stamp unreadable, except the date 16 (1916).
- FIG 63. "£10 SILVER. AVERY" Iron weights for 'counting' silver coins in banks, are very rare.
- FIG 64. "5 LB" Avoir weights of the series 5,10,20,50.. had to be octagonal, by the 1907 Regulations. Lead plug underneath stamped, simply 6 over 73. (6 = Birmingham or June. 73 = 1973).
- FIG 65. "2" (1b) Lead plug underneath, stamp obliterated. Pre 1907.
- FIG 66. "CRANE FOUNDRY CO. WOLVERHAMPTON $\frac{1}{2}$ lb" and " $\frac{1}{4}$ lb". Lead plugs on top, stamp obliterated. Diamond registration mark underneath for the year 1872, see Fig 45, page 617.
- FIG 67. "IMPERIAL STANDARD I. & D. GREEN 4 oz" Adjustment hole underneath. This company changed to David Green alone, in 1828. Cross-section H in drawing 1, page 583.
- FIG 68. "1 $\frac{1}{2}$ oz" The lack of adjustment, and unusual denomination suggest domestic or factory use.
- FIG 69. "2 LB" Lead plug underneath stamped J.B. over S in a shield. This mark is said to be for Bury St. Edmunds, the first letter indicating the date or district. Cross-section L, drawing 1, page 583.
- FIG 70. "WHITEHOUSE. TIPTON $\frac{1}{2}$ lb" Three adjustment holes underneath, copper plug on top, stamp obliterated, pre 1907.
- FIG 71. "J. GARLAND & CO. $\frac{1}{4}$ lb" Very large lead plug underneath stamped with the 'fleece' (hanging sheep) of Leeds. Pre 1878.
- FIG 72. No denomination (2 lb). Lead adjustment on top, stamp obliterated. First half of the 19th century. Cross-section G, drg 1, P 583.
- FIG 73. "COLLINGS & WALLIS. BIRMINGHAM. IMPERIAL 4 lb" Small copper plug on top, mark unreadable. Pre 1907.
- FIG 74. "P. ROGERS & CO. IMPERIAL 1 lb" Three adjustment holes underneath, lead plug on top, stamp obliterated. Pre 1907.

ACKNOWLEDGEMENTS

The author thanks Albert Rangeley, Graham Kendall and Dick Brignall for their kind permission to photograph their weights.

REFERENCES

Weights & Measures Acts, 1824, 1864, 1889, 1897, 1904. Regulations 1890, 1907: The Inspectors Vade Mecum 1910: Parallel W. & M. Regulations by Howard Cunliffe, Shaw & Sons, London 1908. Manufacturers catalogues and advertisements. Trade Directories. Old English Lead Weights by Maurice Stevenson, Libra, Vol 1: 2,10,18.



FIG 58.



FIG 59.



Fig 60.



FIG 61.



FIG 62.



FIG 63.



FIG 64.



FIG 65.

MAKERS AND RETAILERS OF IRON WEIGHTS IN BRITAIN

ACME	-	19th C.
A.C.N. = Aire and Calder Navigation	-	19th C.
A.K. & SON see Kenrick		
ALBION FOUNDRY LTD.	Tipton, Staffs.	1932 - 1966
ATHERTON. A & CO.	Wolverhampton, Staffs.	1844 - ?
AVERY. W. & T. LTD.	Birmingham	1891 - cont.
B.B. & SON	-	-
BULLOCK. William & CO.	West Bromwich	1820 - 1885 end.
BUSHELL	York.	20th C.
B.V. & CO.	-	20th C.
CANNON IRON FOUNDRY	Coseley, Staffs.	1855 - 1884
CANNON IRON FOUNDRIES LTD.	Deepfields, Staffs.	1886 - 1920
CARRON	Falkirk, Scotland	1760 - 1881 -
C'B'DALE see Coalbrookdale		
CHESHIRE. Thos. & CO.	Liverpool	1844 - 1894
CLARK. S.	-	-
CLARK. T. & C.	-	-
CLARK. T. & C. & CO.	Wolverhampton	1876 - 1896
COALBROOKDALE CO. (C'B'DALE)	Coalbrookdale	1709 - 1860
COLLINGS & WALLIS	Birmingham	1872 - 1876
COTTON. William,	Greatbridge	1862 -
CRANE. C.H.	Wolverhampton	1880 -
CRANE FOUNDRY CO.	Wolverhampton	1844 - 1872
CROSS. Wm.	West Bromwich	1871 - 1877
CROSS. William & Son.	West Bromwich	1885 -
CROSS. Wm. & Son LTD.	West Bromwich	1894 - 1940
DIXON & VARDY	-	19th C.
F.M. & CO.	-	-
FALKIRK IRON CO.	Grahamstown, Scotland	1820 -
D.G. & CO.	-	-
GARLAND. James & CO.	Birmingham	1882 - 1898
GREEN. David	Coseley, Staffs.	1828 - 1854
GREEN. D.G. & SONS	-	-
GREEN. I. & D.	Coseley, Staffs.	? - 1828
GREEN. Thomas & CO.	Coseley, Staffs.	1888 - 1936
HOE. Robert.	London	1681 - d1728
HOLCROFT. T. & SONS (T.H. & S)	Wolverhampton	1879 -
HUNT. William & CO.	London	1871 - 1905
IZONS & CO.	Birmingham	1826 - 1870
J. & J.W. see Whitehouse		
JOHNSON	Saffron Walden	19th C.
KENRICK. Archibald & SONS.	West Bromwich	1830 - 1877
LAMB. Percivall	London	- d1725
MIDDLETON. Jas.	-	19th C.
MILLWARD. John.	Birmingham	1870 - 1881
MORVAN	Birmingham	19th C.
ROBBINS. E.	-	19th C.
ROGERS. Peter & .CO.	Birmingham	1860 - 1919
SIDDONS. Joseph & Jesse LTD.	West Bromwich	1888 - 1926
SILK. Edward & CO.	Greatbridge, Staffs.	1871 -
SUTCLIFFE. H. & CO.	Manchester	1820 - 1913
SWAIN. Matthew LTD.	Manchester	1906 - 1922
T.H. & S. see Holcroft		
T.N. & S.	-	19th C.
W.C. possibly Wm. Cross		
WHITEHOUSE. Jabez & John	Tipton, Staffs.	1848 - 1940

Dates are the earliest and latest so far discovered.



FIG 66.



FIG 67.



FIG 68.



FIG 69.



FIG 70.



FIG 71.



FIG 72.



FIG 73.



FIG 74.

Notes & Queries

NQ 71 WEIGHING MEDAL

Note from G.Batz.

I am sending you details of a rather interesting "go-with" for coin weight collectors. It is a medal, designed by the Swedish artist Bo Thoren, which depicts a mint master of the 15 century checking the weight of the coins. Its diameter is smaller than the illustration, 46mm (1.8"). It was a limited edition, but may still be available from the Swedish Mint, P.O. Box 401, S-631 06, Eskilstuna, Sweden. Silver and gold versions were available as well as the bronze one shown.



NQ 72 HOLES & MARKS ON WEIGHTS

query from D.Dörr.

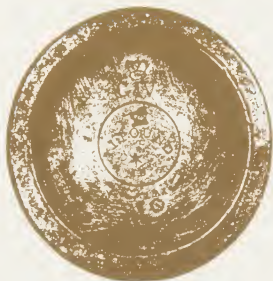
In an antique shop in Perth, Scotland, I bought a 4 lb flat weight made of brass. I think the front is normal - it has the inscription 'AVOIR' - but the back seems unusual. There are a lot of holes and three of them have a screw thread. In the screw thread there are some traces of lead. The measured weight is 1790 grams. Please can you tell me if it is unusual in Great Britain to correct weights by boring different holes? When was the inscription AVOIR used?

Also, please can you tell me something about the marks on the 1 lb brass weight?

REPLY

from the Editor.

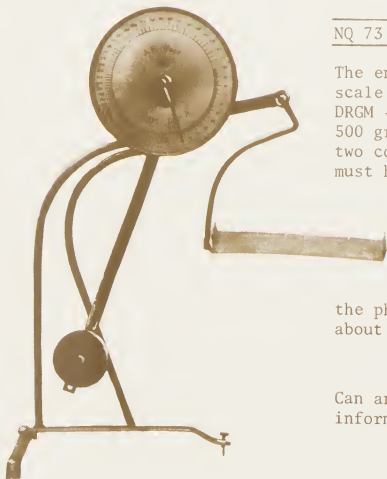
Before 1890, there was no control over the method of adjusting weights. Brass and bronze flat round weights were usually adjusted by turning a shallow depression on the underside, but a few had a single hole drilled and plugged with lead or copper. Iron weights were often drilled with 1, 2 or 3 holes. However, from 1890 onwards, legislation required only one hole to be used for adjustment, underneath the weight. Your weight is most unusual in having so many holes. They appear to have been drilled to make the weight light for some special purpose - it is 24 grams underweight



- or possibly as a means of attaching the weight to some other object (hence the screw threads). The threads could have been intended to retain lead plugs. The inspector's date stamps, 05, 07, 09, 15, show that the weight was correctly adjusted to 4 lb, until 1915. Some time later, the plugs were stamped with an asterisk* to show that the weight was no longer of legal weight for trade.

AVOIR (avoirdupois) has never been a legal requirement, but began to be used on weights, occasionally, in the second half of the 19th century.

Your 1 lb weight has the mark for George IV, who reigned from 1820 to 1830. The boar's head was the mark for the town of Bradford, before 1878. The rose and YWR was for the Weights and Measures district, Yorkshire, West Riding, i.e. the division of the county in which Bradford is situated. (Other districts were YNR - Yorkshire, North Riding, and ERY - East Riding of Yorkshire). I have not been able to identify the Star - MB mark.



NQ 73 AE - WAGE query from D.Schmitz.

The enclosed photograph shows an unusual scale with the marks A.E. - WAGE and DRGM - DRP A. The face is graduated 0 to 500 gram, and the pointer is turned by two cog-wheels at the back. The scale must have been produced before 1927, because later, the word Wage, meaning scale, was written with two a's, i.e. Waage. The height of the scale is 350mm (13.7") and the face is 110mm in diameter (4.4"). Perhaps you could publish the photograph and request information about A.E.- Wage ?

Can anyone help Dirk Schmitz with information about his fascinating scale ?

Precision Balance 5

HANS JENEMANN



FIG 1.

This is a very beautiful long-beam balance, of high precision, made by Carl Stollnreuther, in Munich c1880, Fig 1. This type of balance was used by officials in the Office of Weights and Measures in Bavaria.

The beam has a length of 240mm (16.5"), and is of lattice form. This design gives the beam a low mass, without reducing the stability appreciably. (The lowest possible mass has always been required for good sensitivity of a balance). Additional strength is given to the open form by vertical members joining the upper and lower arms (they are hidden by the door frames in the picture). The pans, of 110mm (4.3"), are suspended by chains made from connected little balls. Readings on the small graduated arc are shown by the deflections of the long downward-facing pointer (compare with Precision Balance 3, on p.589, 590). The Stollnreuther balance could carry a maximum load of 500g in each pan, and the sensitivity was 1mg. The column is not the usual round form, but is rectangular in section, tapering towards the top.

The dimensions of the case are 590mm long, 250mm deep, and 550mm high (23.2" x 9.9" x 21.6"). The two doors of the case open towards the front for access to the pans - a typical arrangement for old long-beam balances. The rugged base is 17mm thick (0.6"), mounted on a cast-iron frame.

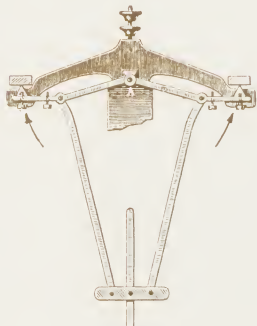
FIG 2.



Precision balances have very fragile knife-edges which need protection from wear and damage. This is achieved, on most balances, by the 'parallel-arrestment gear' by which the beam is moved upwards for use or downwards for arrestment, by a sliding rod inside the hollow column. The rod is raised or lowered by a cam gear when the arrestment knob is turned.

The unusual feature of the Stollnreuther balance is its 'circular-arrestment' gear, Fig 2, invented by the famous Russian chemist D.I.Mendelejew (1834-1907)*. It comprises two pivoting arms which swing up around the central bearing and lift the beam off its knife-edges, as shown by the arrows in Fig 3. The circular motion should ensure that the three knives of the beam always come down in the same position on their bearing planes, each time the beam is arrested and released. However, in practice, this system was very difficult to make and presented serious difficulties to the manufacturer. One pivoting arm could be slightly different in length or motion, and this little asymmetry would lead to the beam landing in very slightly different positions on the bearings, causing errors in weighing. It was to avoid this problem that most precision balances had the simpler parallel arrestment.

Carl Stollnreuther (1816 - 1892) was a mechanic in Munich, and later, also became a member of the Office of Weights and Measures of Bavaria, (Bayerisches Landesamt für Mass und Gewicht). He was the first to make practical use of Mendelejew's invention, although it was in a modified form. He exhibited a precision balance of his own construction, with the special form of circular arrestment, at the 'International Exhibition of Scientific Instruments' in London, in 1876. This balance had a construction similar to that shown in Fig 1.



F.Sartorius, of Göttingen, also preferred the circular system and used it, in a modified form, for many years, on his analytical balances. Several other makers copied his system.

* Mendelejew's invention was reported in the *"Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences"* Vol.80, Paris 1875.

FIG 3. Mendelejew's circular arrestment gear. Swinging arms, pivotted at 'A' are moved upwards by the near-vertical links. Screws in the arms lift the beam and the stirrup ends off their bearings.

Old Advert

This advertisement from the mid 19th C. lists typical products made by ironfounders. Weights were only a small part of their business. The small text reads:-

Mortars & Pestles. Best Cast Hinges. Iron and Brass Framed Pullies.
Hot House Pullies. Door & Stable Latches. three & four Wheel Castors.

French Castors. Knockers. Italian Irons best and common.

Sad Irons. Toy Irons. Sink Traps. Scale Weights. Door Scrapers.

HUMANE MAN TRAPS

Cast Sash Nails. Bills. Common three Leged Pots. French Pots. Spanish Pots.

BAKE PANS &c. &c.



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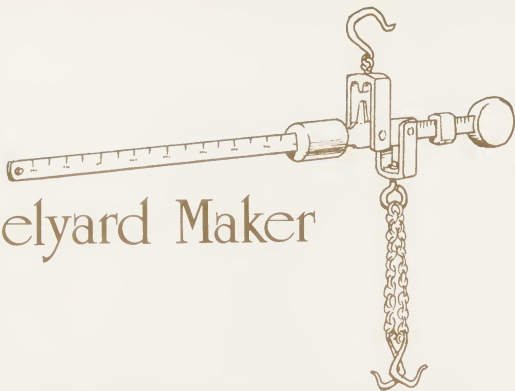
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Cast Sash Nails. Bills. Common three Leged Pots. French Pots. Spanish Pots.
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Yekeri - Steelyard Maker

MICHAEL CRAWFORTH

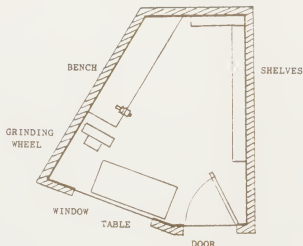
It was April 1975, and Diana and I were on holiday in Istanbul. We had chosen a hotel near the centre of the city so that we could walk everywhere and miss no details of life in the capital of the old Byzantine empire. We wandered away from the normal tourist areas to see the 'real' Istanbul, and, to our great delight, we found a street of scalemakers, coppersmiths and makers of coffee mills. Reverberating sounds from hammers and saws emanated from open-fronted shops which were festooned with newly-finished products. Surely, it was just like parts of London or Birmingham in the 18th and 19th centuries ?

We were attracted by the sound of hammering coming from a small shop on the corner of Atlama tasi caddesi. When we peered through the dingy little window we saw a heap of old-fashioned steelyards - it was the workshop of Yekeri, the steelyard maker. Moving along to the open doorway, we decided there was just enough space for us to squeeze into the little room.

Inside, it was dark and, after the bright sunlight outside, it was difficult to decipher the dark shapes which cluttered the workspace. As our eyes became accustomed to the dim light, we saw that the workshop tapered towards the rear. At the very back, and along the right wall, there were shelves laden with parts of steelyards, rusty old equal-arm scale beams, and piles of rusty tangled chains. An iron table in front of the window was stacked with newly-made steelyards, and one corner was being used as a secondary workbench. Under the table, under the bench and below the shelves, there were piles of rough-cast brass steelyard poises and iron shackles; roughly forged beams and hooks; pans and chains, all waiting to be finished and assembled. Many old steelyards, and parts of steelyards, were suspended from hooks in the ceiling - a hazard to tall inquisitive scale collectors!

Along the left wall was the main workbench with a large vise, and next to it stood a huge grinding wheel. Two men were working at the bench, hand-filing and finishing parts for a steelyard. We watched them for half an hour while they completed the assembly and used test weights to graduate the blade. Marks were made on the blade with a pointed scriber against the sliding brass poise. More test weights were placed on the load hook, the poise was moved to the new position of balance, another mark was scribed, and so it went on, to the full capacity of the steelyard. When the final

Yekeri's workshop tapered towards the rear. The light barely reached the back wall, but in the gloom we could see all kinds of fascinating bits of steelyards and scales.



mark was scribed, Yekeri took a hammer and chisel and skillfully made the marks deeper. After final tests, the steelyard was placed with the others on the pile near the window, to wait for the visit from the inspector, and, hopefully, to receive his stamp of approval.

Two sizes of steelyard were being made, 80 kg and 100 kg, in capacity. The main poise was moved in 1 kg increments, and the subdivisions were measured by a small poise on the load side of the beam, which was graduated 0 - 1000g. Both poises were polished brass and the rest of the instrument was iron and steel with a 'white' finish, that is, cleaned to a bright metal surface, but not polished.

It was a fascinating visit which threw a practical light onto our historical research, and I wished I had not left my camera at home !



Showcase

1. "Trip scales" with side beam. Marked on the centre "PENN SCALE MFG CO. INC. PHILA. PA. U.S.A."
JERRY KATZ COLLECTION
2. Unusual spring dial-face scale marked "PERFAS Marque Déposée. Force 5Kg Breveté S.G.D.G." Height 400mm (15.7"). Pan diameter 200mm (7.9").
HERBERT GRIESHABER COLLECTION
3. Beranger shop scale with a trade mark of a hand holding a plumbline over a mason's square with the initials C.W. Capacity 5kg.
HERBERT GRIESHABER COLLECTION

SHOWCASE



Redeeming Trade Dollars

The United States Sub-Treasury in Wall Street has been busy during the last two months with the redemption of those white-faced trade dollars which were so ignominiously dismissed from circulation several years ago. There were some seven million trade dollars in all, and by an act of the last Congress, the New York Sub-Treasury was called upon to redeem the entire lot at one hundred cents apiece. The movement to redeem the trade dollars started in President Arthur's time. When the dollars were forced out of circulation by an interesting exercise of co-operative power on the part of the public, they passed into the hands of speculators, who bought

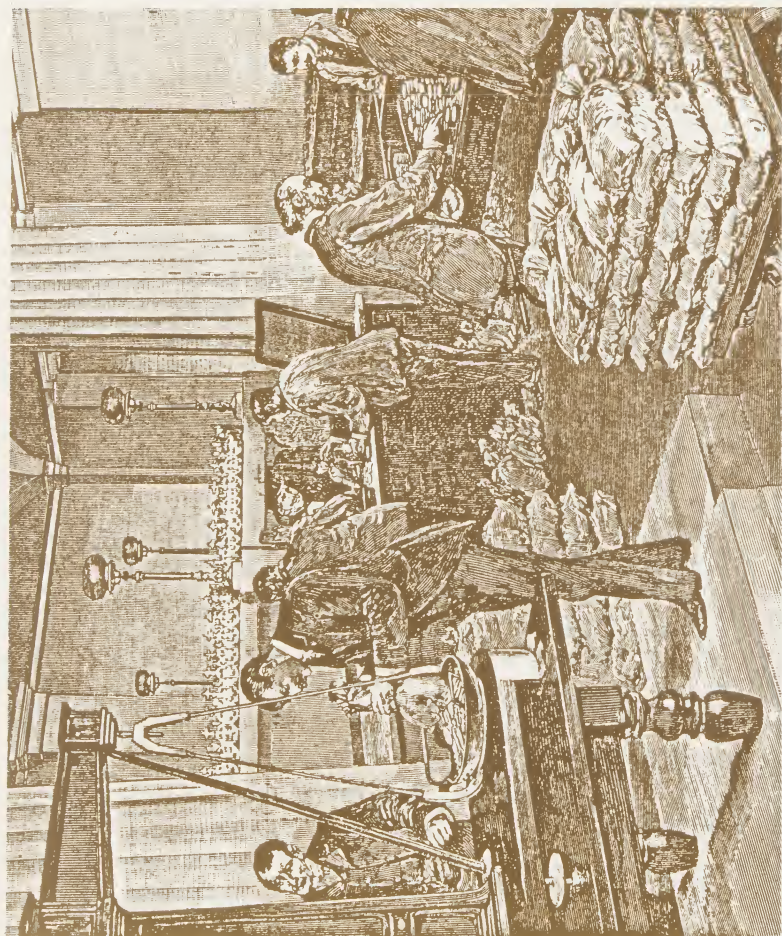


TWO TYPES OF TRADE DOLLAR.

them for eighty-five cents each, or less, and held them with a fine faith in what the future could be made to bring forth. At one time, under President Arthur, their speculative value ran up to ninety-five cents, and at another time, under President Cleveland, it ran down to seventy-seven cents. Their final redemption at one hundred cents leaves a fairly good profit to the holders.

Three or four millions of the outcasts have been redeemed, so far. Nobody knows, of course, when the last one will have been gathered into the Sub-Treasury. Not a few are in China, where square holes have been cut in them to make them resemble Chinese money. These, the Sub-Treasury will not redeem, so it would be useless for any one to send them over here. In fact, no trade dollar is redeemed which is mutilated, and it is because mutilated specimens must be looked out for that the redemption of the outcasts is attended with so much labor. Each one of the three or four millions which have come in has been handled separately. The Sub-Treasury melts the trade dollars up for the silver which is in them - there is considerably less than a dollar's worth in each - and the government pockets the loss.

This article is from "Redeeming Trade Dollars in the New York sub-Treasury" which appeared in Harper's Weekly of June 4th, 1887. The Editor is indebted to EMIL COHN Jnr. for this interesting item.



Redeeming trade dollars in the New York Sub-Treasury, 1887. The vast size of the balance is not exaggerated.

Patent Postals

MICHAEL CRAWFORTH

A SURVEY OF POSTAL SCALES PATENTED IN BRITAIN, 1840 TO 1940.

1900 18 Jan. No. 1131. T. & H. SALTINSTALL-TAYLOR

See Fig 69.

A paperknife is combined with a letter balance of the steelyard/bismar family. The clip for the letter is moved along a slot in the blade and indicates weight and/or postage on the graduations.

This 'shelf-edge' balance has the merit of great simplicity. The thicker part forms the handle of the knife and the weight for the balance. A sharp corner on the handle is used as a knife-edge for the instrument to pivot on any convenient flat surface. It appears that the instrument is made in one piece, with the addition of one moving part, the letter clip. The Abridgement suggests no material for its manufacture. No example has been seen by the author.

FIG 69.



FIG 70.



FIG 69. Saltinstall-Taylor's unusual shelf-edge balance. The suspension clip for the letter is moved along the slot.

FIG 70. The clip, cap and pen of Burrow's instrument retract into the body.

1901 8 Nov. No. 22565. P.F.M. BURROWS.

See Fig 70.

A pen or pencil is combined with a spring letter balance. An internal clip is used to retain the balance in its stored position.

This is yet another combination of a letter balance with a writing instrument. It is shown ready for weighing, in Fig 70. When closed, the centre rod and letter clip is pushed into the instrument so that the two small curved springy pieces snap securely into the cupped socket in the middle of the body. The curved-conical cap also retracts to form a smooth neat body for the pen. No example has been seen by the author, unfortunately, this being a nice example of the genre.

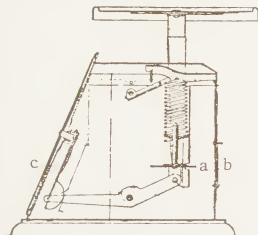


FIG 71. (left) Triner's spring balance showing the screw 'a', door 'b', inclined face 'c'.

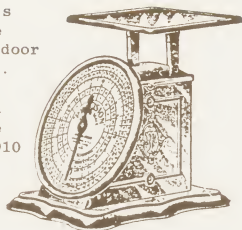


FIG 72. (right) Postal scale from the Triner catalogue of 1910 Capacity 4 lb x $\frac{1}{2}$ oz.

1904 25 Oct. No. 22949. J.M.TRINER

See Fig 71.

A half-roberval and spring mechanism has a top pan and an adjusting screw at the bottom. The screw can be adjusted by reaching through a small swivelling door at the back. The bottom arm of the mechanism is extended and operates a rack and pinion to rotate the pointer. The graduated dial is set at an angle to face the user.

The novelties here seem to be the concealed adjusting screw, and the sloping dial-face which provides greater convenience and improved accuracy in reading by the reduction of parallax errors. Postal use is not referred to by the patentee, but American collectors will be familiar with many letter/parcel balances made to this design by the Triner Company in the USA. They also made grocer's, confectioner's and kitchen scales on the same principle.

1905 23 Jun. No. 13005. A.B.MEES

See Fig 73.

A balance beam with an integral weight has two built-in knife edges, one underneath the instrument for the main fulcrum, the other for the letter. The capacity may be made variable by the addition of extra weights, or by means of a sliding weight, or by moving the knife edges.

The basic instrument, shown in the illustration, must be one of the simplest balances ever devised. Reasonable accuracy is retained by the use of two knife edges. One rests on any convenient flat surface, the other forms the pivot for the letter which must be balanced, precariously, its centre of gravity on the knife edge ! The balance appears to be made from a single piece of material, but no material is specified. Fig 75. shows the author's interpretation of the drawings. No illustrations of the other variations are shown in the Abridgement. No example has been seen by the author.



FIG 73. Mees' simple and unusual letter balance. (see also, Fig 75).

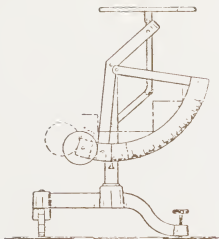


FIG 74. (left). Staudenmaier's pinned quadrant.

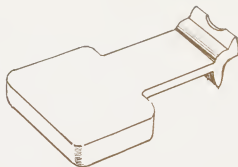


FIG 75. (right). Interpretation of Mees' idea.

1906 10 Feb. No. 3286. C.STAUDENMAIER

See Fig 74.

A typical German pendulum letter balance has the addition of pins which can be placed in holes corresponding with the most usual points of graduation. The pins bring the pointer to rest quickly. They may be re-positioned, or removed.

As mentioned in the introduction to this series (EQM p 398), this is a good example of how misleading a patent can be. At a quick glance, one might assume it was the first patent for this type of pendulum balance. Only when the details are read does one discover that the patent covers the pins alone. The slight saving in time hardly seems worth the bother of putting pins in, moving them to other holes, and so on. Perhaps that is why no example has been seen by the author !

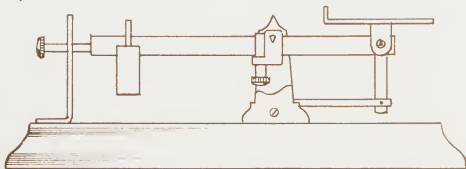
1906 18 Sep. No. 20689. S.MORDAN & CO. and R.LANGHORN

See Fig 76.

A typical table steelyard and half-roberval scale has a multi-sided beam. Each side has different graduations for different rates of postage. The beam can be rotated and locked in the desired position by a spring-loaded plunger, or by a series of pins and holes.

This idea comes from the 'good old days' when postage rates remained stable for many years, but it seems to offer no advantage over Fairbanks' design of 1878, patent No.1774 (EQM p509, 511). The scale seems practical and useful for offices handling mail for different countries, etc. No example has been seen by the author.

FIG 76. Mordan and
Langhorn's
postal steelyard
with multi-grades
and rotating beam.
('A' frame cut
away for clarity).



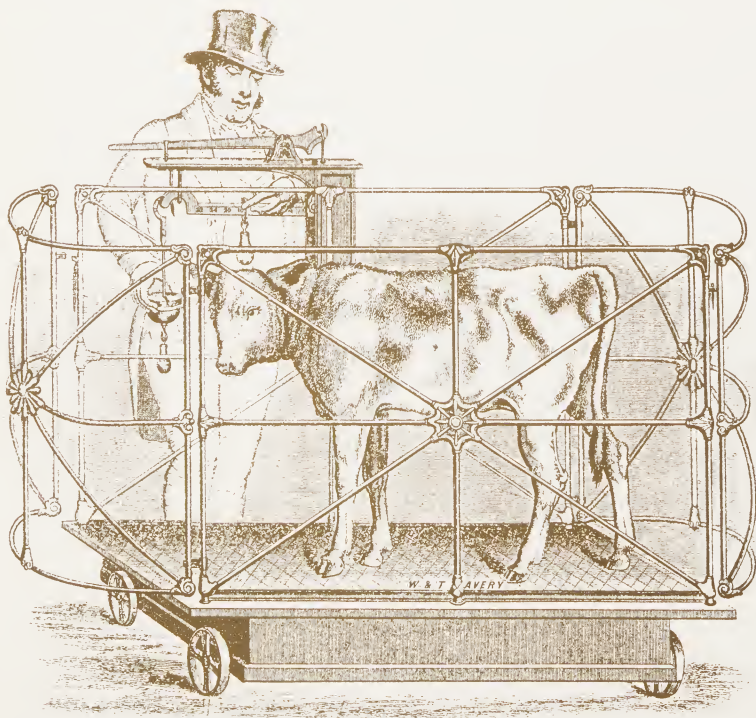


EQUILIBRIUM

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1984—ISSUE NO. 2

PAGES 653-680



Cover Picture

This charming illustration from the c1840 catalogue of W.& T.Avery, was entitled "Portable Machine on Wheels. No.109 Medium - for Weighing Pigs or Calves, Platform 62 x 32 in". A well-dressed Gentleman farmer is shown placing a slotted proportional weight on the hanger at the end of the steelyard blade. At the same time, he is adjusting the hanging poise along the blade, which is graduated 0 - 28 lb (2 stones). Above the steelyard is a lever for relieving the weight from the knife-edges when the animal is being moved on or off the platform via the gates at each end. The artist omitted the lower half of the pillar, which should be visible behind the front leg of the calf.

The design of this platform scale was based on that of Thaddeus Fairbanks. An account of how this came about, is in Part 3 of the article which begins on page 655.

Literature

Collectors interested in old, rare or obscure literature about Scales and Weights will be pleased to learn that good quality electrostatic copies can be obtained for private research (for the cost of copying plus postage). This excellent service is offered by ISASC members Norbert Schwermann and Dirk Schmitz. Their list of works available contains 227 books and articles, mostly in German, but including some English and other languages. Members can obtain this most useful list from Norbert Schwermann, Aternstrasse 1, 3204 Nordstemmen, West Germany.

INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

Founded September, 1976

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FIG 1. see p661

Early Platform Scales

MICHAEL CRAWFORTH

Before the mid-18th century, weighing heavily loaded waggons was a slow process. It was necessary to attach chains or ropes to the waggon wheels and then to lift the weighing machine and waggon into the weighing position using a manually operated winch, Fig 2. An 18th century account of the procedure (1) described it as an "*...incommodious means; the horses were taken out, and the carriage slung upon pulleys etc. fixed in large beams for that purpose.*" As long as this remained an occasional procedure, there was little incentive to improve the apparatus, but in England, the situation changed, almost overnight, with the passing of the Turnpike Act in 1741. This Act authorised all road trustees to erect, at toll gates, "*...any crane, machine or engine, which they shall judge proper, for the weighing of carts, waggons or other carriages.*" "*...they shall weigh such carriages and goods, and take 20s a cwt* above 60 cwt, the money to be applied to the repair of the roads.*" Coming at a time when Britain's road transport was increasing with the development of the industrial revolution, the Act made it essential to discover a quicker method of weighing waggons.

* cwt = hundredweight (112 lb).

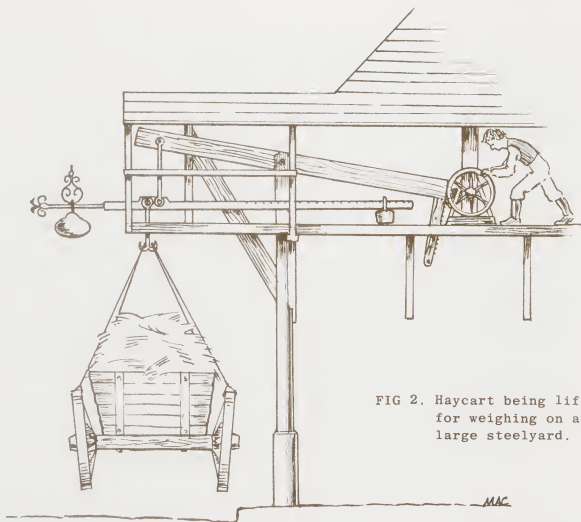
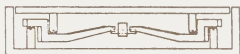


FIG 2. Haycart being lifted
for weighing on a
large steelyard.

One of the first men to solve the problem was John Wyatt. Born in 1700, he worked at first, in his native village of Thickbroom, Lichfield, 12 miles from Birmingham, where he became a master carpenter. He was an inventive man who worked on a number of ideas for improving industrial machinery. Around 1733, he invented a yarn spinning machine, and in order to obtain mechanical assistance with its development and manufacture, he moved to Birmingham. There, a company was formed and the new machines were installed in a cotton mill. Although ingenious, the spinning machine had a number of faults, and the business was not a commercial success. Unable to pay his debts arising from this manufacturing venture, Wyatt was sent to debtor's prison. His correspondence of that period suggests that it was during his long hours of contemplation in prison that he wrestled with the problem of speeding-up the weighing of waggons. His solution was simple, and brilliant - the compound lever platform scale, Fig 3.

To appreciate Wyatt's achievement, it is necessary to understand some of the practical problems involved. A weighing machine was needed onto which a waggon could be driven and weighed without disconnecting the horses. One solution would have been to adapt the existing overhead steelyard design, Fig 2. by attaching a platform to the chains, and using ramps so that the waggon could be driven straight on to it. However, the necessary overhead structure would have been massive and expensive, and commercial loads were

getting heavier, as industry developed. How much cheaper and more convenient, if the weighing beam could be near the ground, where it would be easily accessible and require a minimum of supporting structure. For example, if the platform was attached directly to the top of the weighbeam, and the whole apparatus was set into a pit level with the ground, the requirements would be satisfied, with one important exception - the problem which had prevented such a simple solution for centuries. The weight indicated by the beam would vary according to the position of the waggon and its centre of gravity, giving grossly inaccurate results. So, a means had to be found to apply the load always at the same point on the weighing beam, no matter where the waggon was placed on the platform, or where the goods were located on the waggon.



← FIG 3. Wyatt's weighbridge.

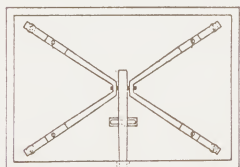


FIG 4. The VV arrangement. →

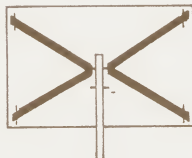
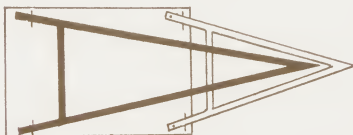


FIG 5. The AA arrangement. ↓



John Wyatt's solution was to support the platform on two intermediate levers which could be connected to one point on the weighbeam. Each lever was shaped like the letter 'V', and lay horizontally below the platform, point to point, (the VV arrangement). They were pivoted at the ends, on pedestals, and, inset from the ends, there were bearings to support the platform, Fig 3. The point of each V-lever rested upon a pivot pin set into the weighing beam.

The beam, itself, had fixed unequal-arms, and weights were placed, centrally, on a small platform fixed to the end of the beam. As the V levers also had unequal arms, there was a substantial mechanical advantage from the lever system. Thus, for weighing heavy loads, only small 'proportional weights' were required.

The type of pivot used by Wyatt is not known, but Benton (5) considers it most likely that the knife-edge was used, as this was a common feature of large scales at that time. Later copies of Wyatt's machine made by other makers, often had the inferior, but easier to make, cone-and-cup bearings.

Wyatt's first platform scale was erected, at Snow Hill, Birmingham, between 1741 and 1744, soon after the Turnpike Act was passed. Writing

about this scale, Wyatt said that it "...would weigh a load of coal or a pound of butter with equal facility and with nearly equal accuracy." " I will only beg leave to say I believe the little imperfections that are in it are best known to myself." Contemporary reports claimed that weighing a waggon on the new platform scales took only a tenth of the time required for the old overhead steelyards.

The earliest documentary evidence of Wyatt's activities is a letter of 2nd March, 1744, in which Wyatt discussed the erection of a similar scale in Liverpool. When built, this machine had a maximum capacity of just over 6 tons 3 cwt and its 'power' was 20 to 1. In his hand-written instructions to the owners, Wyatt stated :

"Directions to the Person that is to attend the weighing machine:

1. That 1 lb upon the scale is 20 lb upon the bridge.
2. The great weight on the collar is 180 lbs consequently at 6 score to the hundredweight on the bridge = 30 cwt.
3. The 8 small weights that are equal are 60 lbs each, therefore weigh upon the bridge each 10 cwt, or altogether = 80 cwt.
4. The small weights are:

1 of 30 lbs	weighs		5 cwt	0 gr.	0 lb
1 of 24 lbs			4	0	0
1 of 12 lbs			2	0	0
1 of 6 lbs			1	0	0
1 of 3 lbs				2	0
1 of 1 1/2 lb				1	0
1 of 1 lb					20
1 of 1/2 lb					10
1 of 1/4 lb					5
1 of 1/5 lb					4
1 of 1/10 lb					2
1 of 1/20 lb					1

123 cwt. 0 gr. 12 lb.

So that the greatest weight prepared for is 6 t. 3 ct. 0 gr. 12 lb."

Most of Wyatt's correspondence has not survived, so it is very difficult to trace the number of weighing machines he made. Jacob (10) found documentary evidence of Wyatt platform scales built at Birmingham, Pandy, Liverpool, Lichfield, Shrewsbury, Chester, Hereford, Worcester, Gloucester and the Deritend Turnpike. The widespread use of Wyatt's scales was indicated in Pearson & Rollason's Directory of Birmingham, in 1780. Writing about the multitudinous arts and manufactures of that city, the authors state that a Birmingham man invented "...a machine, founded on, and regulated by, mathematical principles, for ascertaining the precise weight of the loading of carriages, such as waggons, carts etc. The inventor of this instrument was so happy as to receive the most striking and unequivocal proofs of its utility in every part of this Kingdom, where it was made use of. It was erected on most of the principal roads, and fully answered the expectations of the proprietors and the public."



FIG 6. Weight ticket dated 1798, from Wyatt's first weighbridge. Revenue from weighing helped to maintain the poor in the Workhouse.

Whether, or not, their use was as widespread as the directory suggests, there can be no doubt that Wyatt's platform scales performed well, to the satisfaction of their owners. Several are known to have been used well into the 19th century. The one built at Chester was in use until its removal in 1868, and the one at Lichfield was used until about 1885.

Around the time he built the first platform scale, Wyatt was employed by the famous firm of Boulton & Watt, at their Soho Foundry in Smethwick, (later to become the home of W. & T. Avery Ltd), but apparently he was unable to afford a patent for his invention. Thus, anyone was free to copy his idea, and copy they did. Wyatt soon found himself competing with plagiarists to obtain contracts, as for example, at Chester. Having replied to an advertisement for a weighbridge, he received the following reply to his tender from the Town Clerk of that City:

"Sir, I rec'd y'rs & communicated the same to ye Mayor & most of the Gentlemen of the Corporation. I rec'd proposals from Cadwick of Dudley, his terms are much ye same of yours, also from a person in Hereford, who will finish it for £70, but I told the Mayor & ye rest that I thought you the most Proper person to compleat it well. I desire you will come over Immediately."

Earlier, when Wyatt was working on his first weighbridge, an alternative solution was being designed. This design was presented to the Royal Society, in 1748, by Dr. Stukeley, and was recorded in their minutes:

"This (weighbridge) was invented by Mr. Eayre so long ago as the year 1741, and was on the 26th of September of that year approved by the Commissioners of the Turnpike at St. Neots, Huntingdonshire, who signed a recommendation of it, as did the late Dr. Desaguliers on the 26th of the same month. And this is the machine now generally made use of at all the Turnpikes."

The Gentleman's Magazine of 1748, reported that Eayre had made "...almost all the weighing machines within 50 miles of London," and also reported the manufacture of weighbridges by another man, Thomas Yeoman. His design was, apparently, identical to Eayre's, and was said by Eayre to have been copied from his own machines.

Joseph Eayre was a mechanic, clockmaker and bellfounder of St. Neots. His weighbridge used bearings at the four corners of the platform, but instead of 'V' shaped levers lying apex to apex, as used by Wyatt, Eayre used 'A' shaped, much longer levers, lying with one overlapping the other, Fig 7. (this is the earliest known illustration of a platform scale). No intermediate beams or levers were used, so the proportional weights were placed on a weight plate suspended from a shackle which passed over the ends of both levers. This was a weakness in the design, because the levers worked on different radii, causing one of the knives to rub on the bearing. Leverage was less convenient than Wyatt's, being only 10 to 1. In this respect it was a precursor of the decimal scale, but full advantage of the decimal system was not taken until many years later when the metric system was adopted.

On the evidence so far discovered, it is impossible to determine which of these two men, Wyatt or Eayre, was the first to invent the platform weighing machine, but it was Wyatt's design which continued in use long after Eayre's design was forgotten.

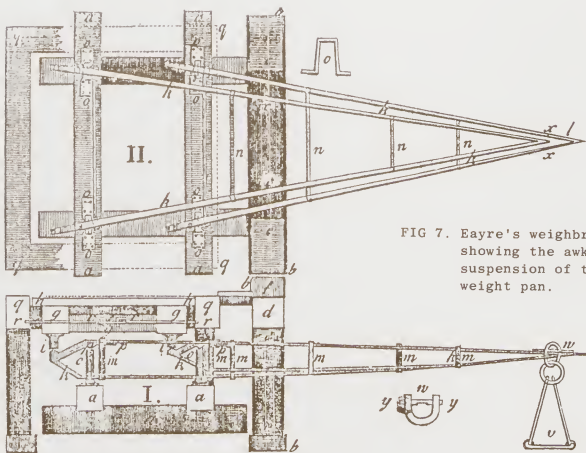


FIG 7. Eayre's weighbridge showing the awkward suspension of the weight pan.

It seems strange to us, today, when patents are scrutinised in great detail, that someone could patent an idea which had already been in common use for over thirty years. However, this was the case in 1774, when James Edgell of Frome Shelwood in Somerset, was granted British Patent No. 1079 for a *"Compound ballance or engine...by which waggons and other carriages, and also all heavy goods, wares and merchandise may be weighed."* Unfortunately, no illustration was provided with the patent, but Edgell described his balance as follows: *"A large...platform is placed nearly level with the surface of the ground, ...so that waggons...or any heavy goods may easily be drawn and placed thereon..."* *"...(the) platform is supported by four legs resting....on four different points of application on the short arms of unequal ballance beams, whose longer arms...meet and are combined or coupled together under the platform."* *"Several levers are inserted between the ballance beam and a scale...that receives the weights"* *"In the scale (pan), so hung to the longer arm...a small weight will equipoise with a large weight on the large platform."*

This description leaves no doubt that Edgell was describing, in principle, a compound lever platform scale similar to Wyatt's invention. It appears to be the first patent for such a scale (a fact apparently unknown to Kisch and other referees listed, and not mentioned in Benton's paper), but, its validity does not seem to have been challenged by the existing manufacturers of platform scales.

The public's attitude to these weighbridges on turnpikes was universally to dislike them, not only for the tolls, but also for the nuisance caused, and the inequitable application of the charges (waggons employed in agriculture, noblemen's carriages, and waggons employed in the king's service were exempt). Weighbridges appear to have been the cause of much trouble and evasion of the law. As Jackman says (11), *"The keeper of the weighing engine was often in league with some or all of the carriers and for a certain weekly sum would allow their waggons with extra weight to pass through without weighing..."* *"...the weights, as given by different engines, were not uniform and a load that would pass at one engine would not pass at another."* It is not clear whether these unequal results were a consequence of bad manufacture or poor maintenance, but the latter seems most probable. Copeland (8) comments; *"The weighing machines were expensive to install and maintain and their accuracy was often in doubt. An estimate for a weighing machine for Shenfield gate in 1826, having a cast-iron plate 13' x 7' 3" quoted £87 complete with brickwork. In 1822, another turnpike trust paid £100 for a machine..."* *"...the tolls arising from the weighing machine ...were not sufficient to pay the expense of keeping it..."*

Parts 2 & 3 of this article will appear in later issues of EQM.

FIG 1. (see page 655) This early platform scale, built in 1836 by Brown Lennox & Co. was based on Wyatt's design. It was used for weighing barges (long boats) on the Glamorganshire canal, so the platform was suspended under water, below the lever system, and is not visible in the picture. The weighbeam can just be seen in the centre, projecting into the weigh-house near the roof. Further details will appear in Part 2.

Fancy Postal Scales

- Funny, Mad, Amusing or Senseless ?

LOU UIT DEN BOOGAARD

Why invent the term 'Fancy Postal Scales'? Because the maker used materials or things which have nothing to do with the principle of weighing, but everything to do with the wishes of the customer - and of course, with the era in which they were made (1840 - 1920).

My first example is a letter scale from the Victorian period, Fig 1. It is not so peculiar as the others, but it is over-decorated. On each end of the quadrant there is a horned ram's head, and at front and rear, a woman's face. They are not concerned with weighing but are there only to make it attractive. The maker's initials underneath the base are P.St.& Co. with a small trade-mark of a man's head with a beard and helmet. The quadrant is graduated $\frac{1}{4}$ to 10 oz.

My second is a scale signed Howell & James Ltd, 5,7 & 9 Regent Street. (i.e. London). The scale is mounted on a mother-of-pearl shell, and all the metalwork is gilded. There is now only one weight, marked 2oz - 4d (the rate for 1840 - 65). It looks like a letter scale for a lady, and of course, for private use. Fig 2.

My third has a bear lying on his back and holding between his paws, a platform supporting a pendulum postal scale. The bear and platform are carved from one piece of wood - and he does not know anything about postage rates or weighing ! Of course, the bear could have been used for many other purposes, a little table lamp, or a flower pot, perhaps? The quadrant is graduated $\frac{1}{4}$ oz to 4 oz. Fig 3.

My fourth example is the worst one! A super-mad postal scale made like a hunting trophy, mounted on the foot of an elk — very heavy and out-of-proportion with the small light scale. It was made by S.T.S. (Samuel Turner, Snr. 1858 - 1920), and is plated with silver. Only one weight remains, 2 oz.

In the main, these scales can be bought at relatively low prices, but today, I think nobody with any brains would appreciate weighing on such extreme examples of Victorian taste. However, for the collector, they serve to remind him of a bygone age.

I would be very pleased to hear from other members who have fancy scales.

Lou's article reveals a humorous and very individual viewpoint. Any comments from readers will be gladly considered for publication. (Would anyone like to use such scales today ?)
- Editor.



FIG 1.



FIG 2.



FIG 3.



FIG 4.

Precision Balance 6

HANS JENEMANN

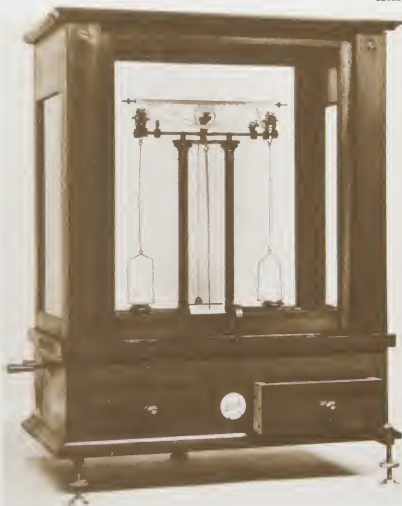


FIG 1.

This assay balance was made around 1910 by the Bosch Brothers in Jungingen in the Swabian Alps (near Sindelfingen, the venue of ISASC Convention 1983). It has no special mechanical features, but stands out because of its elegant styling, made with two columns and filigree work on the beam.

The beam has a length of 160mm (6.3") and is graduated along the top from 0 to 10, on both arms, readable to 0.1g. However, there is no mechanical system for positioning a rider weight. Perhaps the rider was positioned by hand. The balance has a parallel arrestment, operated by a crank on the left side of the case (similar to the example by Bunge, EQM p589). There are two arrestment rods moving inside the two hollow columns. At the front, there is the usual pointer and graduated arc to indicate the inclination of the beam, and behind it, a plumbline for levelling the balance. The maximum capacity may have been 20 or 30 grams, with a sensitivity of 0.05 mg, or a little better.

The dimensions of the case are 340 x 200 x 460mm high (13.4" x 7.9" x 18.1"). There are no side doors, the case being opened by the sliding window at the front. There are two drawers for weights and analytical accessories.

The firm Gebr. Bosch, of Jungingen - which has no connection with the big electrical combine Bosch AG - was founded in 1852. It is still in business today, a family firm run by the fourth generation.

The term 'essay balance' or 'essayer's balance', comes from the late Middle Ages, when analysis of ores was not made in aqueous solution, but by the dry essay method. The mineral sample which was to be tested for its content of precious metals, was mixed with metallic lead. When heated, the precious metals were absorbed by the molten lead. Then the molten "lead king" (in German 'Bleikonig') was separated from the mineral material and was driven-off by the process of 'cupellation' (Treibarbeit). The lead was oxidised to yellow lead oxide, which drained away down side channels or was partly vapourised. There remained a little 'button' of precious metal called in German 'Silberblick' (grain of silver). This was weighed on a sensitive scale - the assay balance. The assaying process was described by Georg Agricola (1454 - 1555) in his 'De re Metallica' libri XII, first published in Basel, in 1556. Agricola's illustration, Fig 2, shows three balances, one for weighing the lead, the second for the ores, and the third one, in a case, for weighing the precious metal. The case protected the balance from dust, warmth, currents of air, and corrosion. Later on, a single assay balance was used for all fine weighing in analytical chemistry and other scientific work.

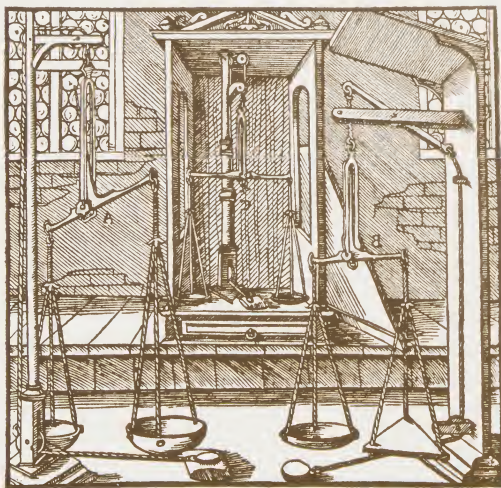


FIG 2



Hay Weighing Forks

THOMAS CARLEY



While researching patents for an article on weighing scoops* I happened to find, in Subclass 131, one lone weighing fork. Shortly thereafter, the late Warren Russell sent me a photograph of a weighing fork that he had recently purchased at an auction in Brattleboro, Vermont ! Fig 1. The brass indicator plate is stamped "Starratt & Masters, Scale Mfgs, Boston, Warranted, Patent." Range 2 - 45 lb. x 1 lb. Subsequently, a friend of Warren's, in Boston, searched old issues of "Boston Almanac" and found Starratt & Masters listed in 1869. They were not listed in 1868 nor in the 1873 issue, which indicates they may have been established only a few years. Could it be that the demand for hay weighing forks was not great? At least, Warren's hay fork shows that the idea went beyond the patent stage.

As the one patent I had received did not appear to cover Starratt & Masters' fork, I was motivated to do some additional searching in patent records. Subclass 148 was duly noted. It is entitled "Hand manipulatable weighers" under "Weigher loading or unloading means". Sampling this subclass proved fruitful as it eventually provided eleven additional patents on hay weighing forks, including the one that covers Starratt & Masters.

The first hay fork patent, in subclass 148, was issued to J.K.O'Neil, on April 17th, 1866, No.54007, Fig 2. (It is interesting to note that the same man was issued with the first two patents on the list of weighing scoops, EQM p492.). His horse hay fork required a lifting system, formed by a rope and an overhead pulley. Its design is clean and simple using existing components for both the spring scale and the grappling fork.

FIG 1. (top) Hay fork by Starratt & Masters, patented by Stewart in 1866. Lower picture shows detail of the weighing section, graduated 2 - 45 (lbs).

* EQM p487.

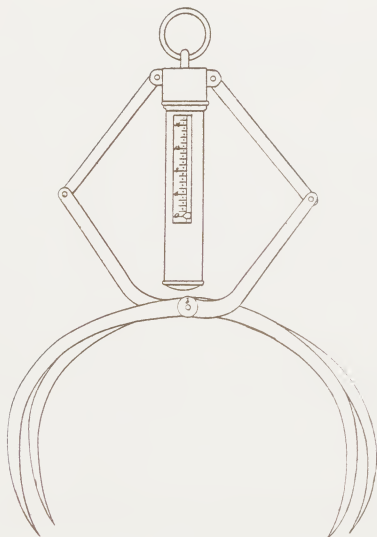


FIG 2. (above) O'Neil's horse hay fork was suspended from an overhead pulley. The fork was self-grabbing due to the 'scissors' arrangement of the levers.

FIG 3. (right) Stewart's hay fork had a spring weighing element concealed in the handle. This design was made by Starratt & Masters, (see Fig 1).



In the same year, J.B.Stewart was granted patent 54435, for a very basic weighing fork, Fig 3. Just stab some hay, elevate the fork to the vertical position, and read the weight on the indicator plate. This is the patent used by Starratt & Masters for their product. The 1866 patent date fits well with the dates we know they were in business.

On September 23rd, 1879, patent 219902 was issued to J.W.Blackhart, Fig 4. It was similar to Stewart's but had a disc at the base of the tines to prevent chaff from falling on the scale mechanism. It also had an eccentric locking device to render the scale inoperative. (This latter feature caused it to be placed in Subclass 131, the category I had investigated earlier.).

The features in these three patents are useful, simple, reasonably practical, and would provide a farmer with almost everything he needed in a hay weighing fork. They were all granted before 1880. Between 1880 and 1938, there were eight additional patents for hay weighing forks. In his claims, each inventor mentions "new and useful improvements". In most cases, the practicability of the improvements seems dubious.

The hay fork is a very elementary but effective tool. Except for materials used in its construction, its design has changed little over the years. In use, one hand remains relatively stationary near the end of the shaft. The other hand must be free to slide over the centre portion of the shaft, depending on how much leverage is needed. Any mechanical device permanently situated in the centre section of the shaft would not only be a "knuckle buster" but an impediment to the smooth rhythm of pitching.

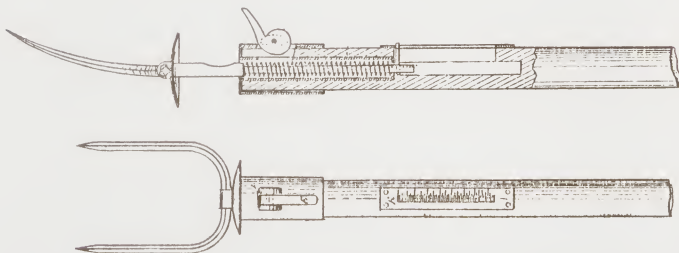


FIG 4. A disc at the base of the fork prevented chaff from falling into the weighing mechanism of Blackhart's fork. The comma-shaped lever locks the mechanism.

An example is shown in the bismar. Fig 5, patent No.223296. Presumably, this was designed as an "add-on" attachment for existing forks. The loop handle assembly slides on the calibrated metal strip anchored to the shaft, and can be locked by tightening the setscrew, so that a predetermined amount of hay can be picked up each time. The counterweight at the end of the shaft (where one hand normally rests) is adjustable and intended for calibration. This fork can be used in two ways: with the loop handle assembly locked on a specific weight setting, the bismar acts like an 'under - over' balance; by releasing the loop handle and sliding it until the shaft is horizontal, the actual weight of the forkload can be read on the calibrated strip.

Patent No.436427, Fig 6. has a two-part shaft connected by a hinge, which serves as a fulcrum. This permits the load on the tines to compress the spring and operate the indicator. The mechanism appears to be in the way of one hand and also very vulnerable to physical damage.

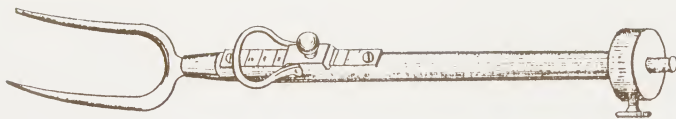


FIG 5. Add-on bismar conversion for a standard fork, patented by Richardson in 1880. Adjusting weight at the end.

F.M.Stevens' patent, No.450642, is the first to have a dial indicator, Fig 7. The dial is capable of making two revolutions. The tines, forward half of the shaft and square rod inside the hollow rear shaft, are all rigidly connected. This assembly is pivoted at the rear of the rod, inside the rear shaft. When a load is applied to the tines, the forward shaft moves downward compressing the spring and turning the dial indicator via a rack and pinion. This is an expensive and complicated mechanism for a hay fork.

Patent No.1210644, Fig 8. takes the prize among this group for complete impracticability. Even readers who have never pitched hay will recognize these bad features! All hay forks have hardened tines and a tempered shank that fits in the end of the wood shaft. This one requires an extra long shank that is, as the patentee says, "resilient or springy in its nature". It is difficult for me to envisage a shank that was rigid enough to properly support the fork and flexible enough to allow the spring scale to register. If the operator was successful in getting a fork-full of hay, the probability was that hay would conceal the indicator!

Some of the patentees mention cost saving as justification for a hay weighing fork. Attempting to visualize these savings one hundred years later is another matter. Where the writer was raised, the farms were large and a farmer's hay crop was normally used for his own stock. For the occasional sale to a neighbour, the quantity would be estimated by volume, rather than by weight, unless a platform scale was conveniently available. The thought of loading a full hay rack with a weighing fork and recording the weight of each fork-full would have been scoffed at by a Mid West farmer.

Most of the inventors came from New England states, where the farms were smaller and the occasion for selling small quantities of hay may have been more frequent. Nevertheless, if a sale involved more than a few forks-full it would seem that the recording problem would again have become a deterrent.

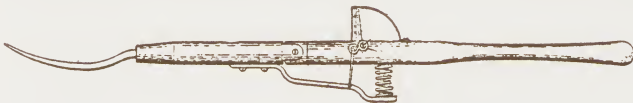
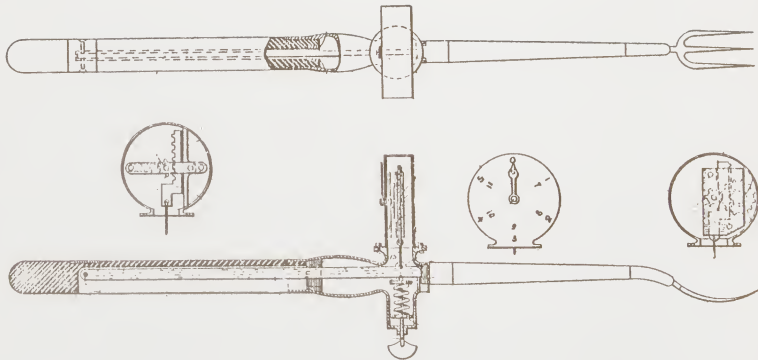


FIG 6. Marston's fork had a hinged shaft and an exposed spring and indicator mechanism - was it vulnerable ?



There is no evidence that the hay weighing fork caught on like the McCormick Reaper. In fact, no evidence has been found, so far, that the weighing fork was ever manufactured in large quantities.

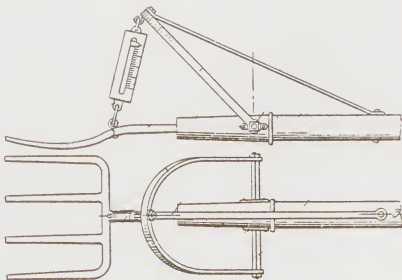
Regardless of the impracticability of some of the designs and the apparent lack of demand for weighing forks, we are, nevertheless, indebted to a few Yankees for contributing an obscure chapter in the diverse history of metrology.

EDITOR'S NOTE: Since this article was written, the author has acquired the Starratt & Masters fork from the Russell estate.

FIG 7. (above) Steven's fork with dial indicator.

FIG 8. (right) Heaney's design relied on flexibility of the metal shank combined with a standard spring balance.

The accuracy of some of these forks, Figs 5,6,7 & 8, would have been affected by the position of the load on the forks. Hay packed well down to the bottom of the tines would have registered lighter than the same hay at the end of the fork.



HAY WEIGHING FORKS. U.S. PATENT OFFICE, CLASS 177, SUBCLASS 148.

1866	Apr. 17	54007*	J.K.O'Neil	Horse hay fork.
1866	May. 1	54435*	J.B.Stewart	Hay fork.
1874	Sep. 29	155391	M.Scott	Weighing attachments for hay forks.
1879	Sep. 23	219902**	J.W.Blackhart	Hay fork.
1880	Jan. 6	223296*	G.L.Richardson	Combined hay fork and balance.
1882	Dec. 5	268747	G.A.Stewart	Fork for weighing hay.
1890	Sep. 16	436427*	N.B.Marston	Weighing fork.
1891	Apr. 21	450642*	F.M.Stevens	Feed fork.
1901	Apr. 9	671853	A.B.Clay	Pitchfork.
1917	Jan. 2	1210644*	D.Heaney	Weighing device for forks or shovels.
1921	May 31	1380199	L.Felix	Weighing fork.
1938	Sep. 6	2129564	E.C.Chandler	Weighing fork.

* Illustrated in this article.

+ Subclass 131.

Old Exhibits

Counter, druggist and laboratory scales, ring and flat weights displayed by The Springer Torsion Balance Co. New York, (c1900?) Print from the original block, sent in by Vernon Denford.

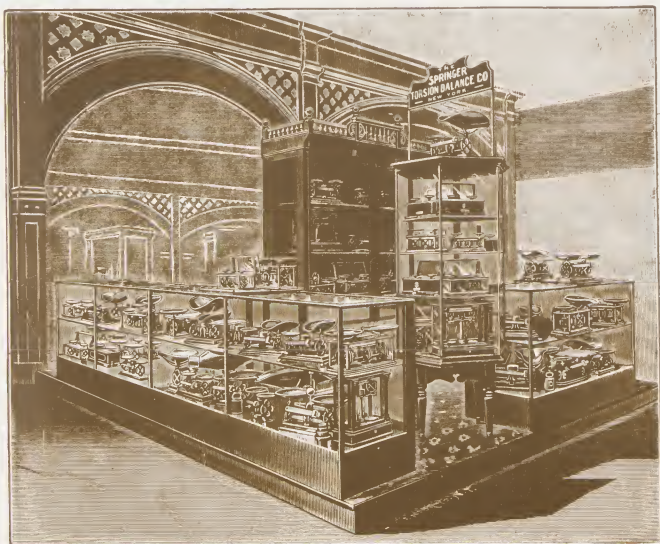




FIG 1.

MICHAEL CRAWFORTH

The recent discovery of an extraordinary folding gold balance, with five turn-over weights, raises some interesting questions, Fig 1.

Three of the turns are unusually large and take up two-thirds of the beam length. They are set in a rectangular frame which crosses over the fulcrum, so the pivot knives are two separate pieces fixed into the sides of the frame. On each side of the frame there is a small turn pivoting on a different centre. These two small turns are identical in mass, so there are 23 effective combinations of weight. The common sliding weight is provided for determining underweight discrepancies for light coins, but the beam is graduated in grains, instead of the usual pennies.

The first question must be, for which coins was the balance designed? Unfortunately, the label of instructions is missing, so the answer can only be deduced by testing the instrument. Results of the tests are shown in the table, Fig 4, where the weight required to tilt the beam fully down is shown against the combination of turns. On the assumption that the balance was intended for use in England, it can be seen that the guinea, moidore and Portugal piece, with most of their sub-divisions, can be weighed, but not the smallest coins, 6s 9d, 5s 3d, and 4s 6d. Also, the half-moidore (13s 6d) cannot be weighed (but it may have been provided for, as will be explained later). Two silver coins could, apparently, be weighed, as two of the combinations are within 3.5 and 1 grain of the crown and half-crown, respectively. (3.5 grains of silver was worth about half a penny). Settings for the gold coins, above, are all within 0.5 grain of the required weight (0.5 grain of gold was worth one penny).

It appears, from the design of the balance, that it may, originally, have been only for the four heaviest Portuguese coins circulating in England, in the 18th century, the £3 12s, 36s, 27s and 18s. These were all catered for by the three turns within the frame. If this was so, then the original concept was later modified to include two small turns outside the frame. This made it possible to weigh a further three gold coins, the guinea, half-guinea and 9s, and two silver coins, the crown and half-crown. These four different coinage systems each had their own mathematical progressions which were not inter-related. Perhaps it was this, combined with the gradual growth of the design, which was the reason for 15 of the 23 possible combinations of the turns being unused.

At the end of the box, near the catch, there are two small iron pins projecting inwards, Fig 2. The wood, between these pins and the catch-plate, is heavily scored where some object has been repeatedly pushed in and removed. The evidence suggests that a thin metal sheet was stored here, with the pins holding it in place. At first, it was thought that a slot-gauge for coins had been stored there. There are several known examples of folders with gauges (although they were not stored in this position - Ref 1). They were for the sovereign and half-sovereign. As the five-turn folder pre-dates these coins, their equivalent would have been the guinea and half-guinea. However, it was found that the diameter of the guinea was too large for a slot gauge which would fit behind the pins.

Possibly a test weight was provided for checking the accuracy of the balance. Such weights were provided for some of the turn-type balances made by A. Wilkinson, T. Houghton and Stephen Houghton & Son, (Ref 1 and 2). The available space is just large enough to take a rectangular flat brass weight

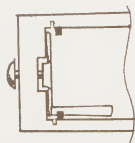


FIG 2. The retaining pins - for a weight ?

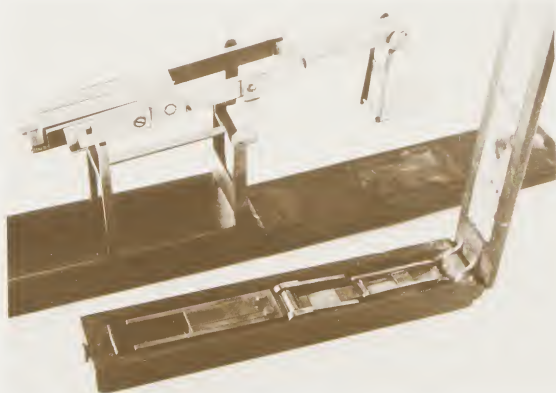


FIG 3. The five-turn folder shown with Wilkinson's standard double-turn folder for the guinea, half-guinea and 7s piece.

POSITION OF TURNS	GRAINS	GOLD COIN	SILVER COIN	POSITION OF TURNS	GRAINS	GOLD COIN	SILVER COIN
All inward	56	9s	-	outwards			
1 or 5	64.5	$\frac{1}{2}$ Gua	-	3	278	-	-
1 & 5	74	-	-	1 & 3 or } 286	-	-	-
4	111.5	18s	-	3 & 5	-	-	-
1 & 4 or } 119.5	-	-	-	1,3 & 5	295	-	-
4 & 5	-	-	-	3 & 4	334	-	-
1,4 & 5	129	Gua	-	1,3 & 4 or } 342	-	-	-
2	166.5	Moid	-	3,4 & 5	-	-	-
1 & 2 or } 175	-	-	-	2 & 3	388	-	-
2 & 5	-	-	-	1,2 & 3 or } 396	-	-	-
1,2 & 5	184	-	-	2,3 & 5	406	-	-
2 & 4	223	36s	-	1,2,3 & 5	444	£3 12s	-
1,2 & 4 or } 231	-	-	$\frac{1}{2}$ Crn	2,3 & 4	454	-	-
2,4 & 5	-	-	-	1,2,3,4 or } 454	-	-	-
1,2,4 & 5	239	-	-	2,3,4,5	-	-	-
				All outward	461	-	Crown

FIG 4.

for the half-guinea, or possibly, a 9s piece. However, all the test-weight sets seen included a test weight for the guinea.

A third possibility, and perhaps the most likely, is that the storage was for a loose weight to adapt the balance for the half-moidore, which was omitted from the various combinations of the turns. A piece of brass sheet, cut to fit in the space provided, was found to be easily made the correct weight for this purpose. Thus, by placing the weight on the coin plate, beneath the coin, and using the combination of turns for the 18s, a half-moidore (13s 6d) could be checked.

Another major question is, of course, who was the maker of the five-turn balance, and when was it made? Although the metal parts are wider than usual, to accommodate three turns in the frame, the side view of the significant parts, the columns, rest and hanger, are all typical of Anthony Wilkinson. Also, the coin-plate shape, the hinge construction and the uncommon catchplate spring are all of his design, (Ref 1). Most significantly, the number stamps on the beam have the same shapes and wear faults, as those used by Wilkinson in his period at Kirkby, before 1785. So, the weight of evidence is in favour of Anthony Wilkinson as the maker, early in his career. Is it possible that he made it before the Great Recoinage of 1774, or did he find that a few customers still wanted facilities for Portuguese coins, in the late 1700's, even when most of

them had been withdrawn ? This was the case, apparently, with the balances signed Jesse Ramsden (Ref 1). The mature and confident style of the metal parts is appropriate to their manufacture being after Wilkinson's early guinea period, that is, after about 1780.

Whatever the answers to these questions, this balance provokes new thoughts about the early developments of folding gold balances, and extends our knowledge of Anthony Wilkinson's ingenuity.

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1. CRAWFORTH.M.A. 'Weighing Coins - English Folding Gold Balances of the 18th and 19th Century.' Cape Horn, London. 1979.
2. SHEPPARD.T. & J.F.MUSHAM. 'Money Scales and Weights' Spink & Son, London. 1926, reprinted 1975.



Showcase

1. A Fairbanks' person scale made c1895. Lower beam graduated 0,100,200,300. Upper beam graduated 0 - 100 x 1/10 lbs. Wood, brass, cast iron.

WAYNE ROBERTS COLLECTION

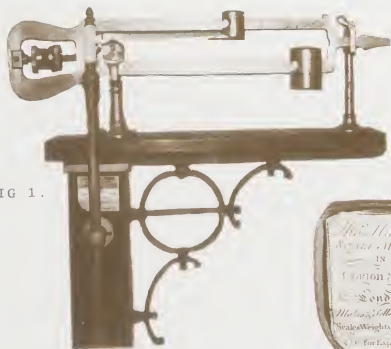
2. Coin scales and weights in a shagreen box, by Thos.Harrison, Scale Maker in Cannon Street, London. The label shows a list of coins current in England in the 18th century, with their weights. Iron beam, brass pans.

LOU UIT DEN BOOGAARD COLLECTION

3. Postal scale by Landers, Frary & Clark, New Britain, Conn. U.S.A. Sheet metal casing painted black with gold decoration. Graduated 0 - 24 lb.

JERRY KATZ COLLECTION





Patent Postals

MICHAEL CRAWFORTH

A SURVEY OF POSTAL SCALES PATENTED
IN BRITAIN, 1840 to 1940.

1911 14 Jan. No. 1025. R.JOKSCH Fig 78.

A half-roberval and steelyard is made with a bent beam so that the instrument is of the 'accelerating' type. A lug cast into the frame supports the beam at rest.

Although postal purposes are not mentioned by the patentee, the apparent size and top pan design suggest that this was one of the uses envisaged. It seems that the scale was intended as a quick under/over balance. The accelerating design results in the beam tilting fully down as soon as the pre-set weight is reached. The slightest under-weight would leave the beam firmly on its rest. Why was the instrument so tall? No example has been seen by the author.



FIG 77.

1913 13 Mar. No. 6367. R.RUHLAND

See Fig 79.

A typical half-roberval pendulum balance has a wide slotted quadrant with two double-ended pointers. One pointer starts in the centre of the quadrant, the other starts at the right end. Each pointer projects through the slot and registers on graduations above and below. Thus, four sets of graduations are provided, one showing the weight and three showing different postage rates

This is a clever variation on the theme of multiple graduations, although it seems to offer no advantage over Horn & Albracht's design (EQM p511) or Golaz' design (EQM p622). No example has been seen by the author.

1915 6 Dec. No. 17126. H.E.MOUL

See Fig 82.

A pendulum balance comprises a triangular plate carrying a weight along one edge. A wire suspension loop and a wire hanger with a clip for letters, are pivoted in the top corner. The bottom edge of the plate is notched and graduated according to weight or postage value, the indicator being the clip hanger.

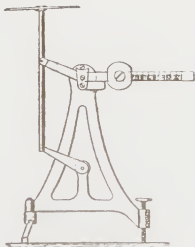
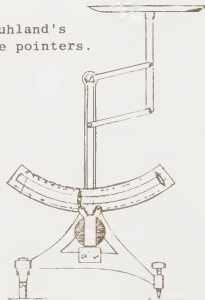


FIG 78. Accelerating Steelyard
by Joksch.

FIG 79. (right) Ruhland's
two double pointers.



This attractively simple idea seems to be crudely carried out in the illustration, presumably in the interest of cheapness - the use of a standard 'bulldog' clip, for example. Why is the clip suspension hanger so long? No example has been seen by the author.

1919 28 Nov. No. 158751. W.& T.AVERY & W.TIMSON

See Fig 81.

A top-pan pendulum balance has a long weight-arm which has a small range of angular motion. A damper is fitted to provide rapid settling of the twin pointers, one on each side of the casing.

The small range of travel of the weight ensures fairly even spacing of the graduations. An inclined graduated arc on each side of the instrument provides convenient indications for the operator and the customer. No specific purpose is mentioned in the abridged patent, but Fig 77. shows an example for postal use.

1927 16 Mar. No. 291895. T.S.MURRAY

See Fig 80.

A hydraulic balance of the 'candlestick' type has a centre rod floating in mercury, or some other suitable liquid. A loose ring around the rod floats on top of the mercury and indicates weight against graduations on the rod. For transportation, the rod is pushed down and screwed into the base, so that a conical ring on the rod seals the top of the cylinder to prevent escape of the liquid.

These ideas are an improvement upon earlier hydraulic balances made in the 1840's. The seal for the mercury deals with leakage problems during transportation (but not if the scale is knocked over in use), and the floating ring gives a more precise indication than the curved meniscus of the liquid. Contemporary writers criticised the 1840's balances because the rod and mercury tended to stick and did not move freely. No example has been seen by the author.

A beam of wood, metal or glass has a series of flat planes on the underside approximating a curve. Each flat is marked with the weight or postage. At one end, the beam is weighted, at the other end is a small clip to hold a letter in the vertical position.

This is a form of bismar, which rocks from one plane to the next until the correct weight bracket is indicated. It must have been difficult to see which plane the device was resting on. No example of this simple device has been seen by the author.

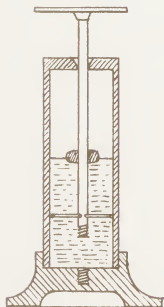


FIG 80. (left) Murray's hydraulic 'candlestick'.

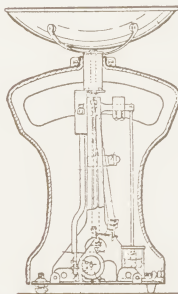


FIG 81. (centre) Pendulum balance by Avery & Timson.

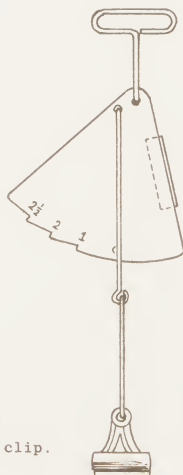


FIG 82. (right) Moul's simple pendulum with bulldog clip.

A combination tool comprises a letter balance, knife, cigar cutter, compasses, ellipsograph and a match striker.

The beam of this instrument is made from a U-shaped piece of metal, in which a razor blade is held, with one edge exposed in a curved recess, for cutting. Another U-shaped piece of metal slides over the beam and can cover the razor blade for safety. A round hole in the slide is used for cutting the end off a cigar. On the side of the slide, a grooved surface is used for striking matches. At the top corners of the slide there are two small projections with holes, and there is a similar projection at the end of the beam. By placing a pin through one hole and a pencil point through another hole, a circle may be drawn, the diameter being set by the position of the slide. An ellipse may be drawn by fixing the ends of a piece of string through the holes, as a guide for the pencil. To weigh a letter,

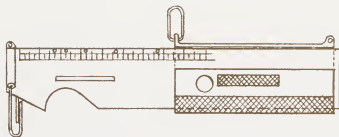


FIG 83. (left) Multi-purpose tool by Rys.



FIG 84. (right) Mahloy's rocking bismar.

the envelope is fixed in the clip at the end of the beam, and the instrument is suspended by the wire loop at the front of the slide. The beam is moved through the slide until the instrument balances, whereupon the weight is read from the graduations on the beam or on the slide. Alternatively, the beam may be suspended from one of a series of holes along the beam. No example has been seen by the author.

1927 19 Nov. No. 280953. M.SLOTOSCH

See Fig 85

A walking stick is adapted for use as a weighing instrument, by a clip at one end for the load, and a plumb-line at the handle. A suspension loop is moved along the graduations on the stick.

By this adaptation, the walking stick becomes a bismar. The plumb-line indicates horizontality against a mark on the crook of the handle. A specific purpose is not mentioned in the abridgement, but a letter is shown in the patentee's drawing. No example has been seen by the author.

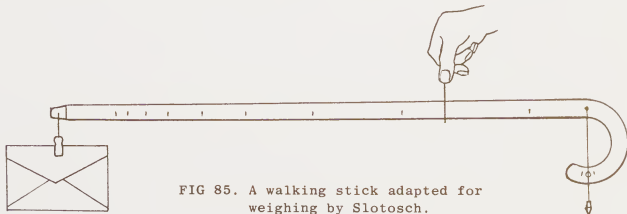


FIG 85. A walking stick adapted for weighing by Slotosch.

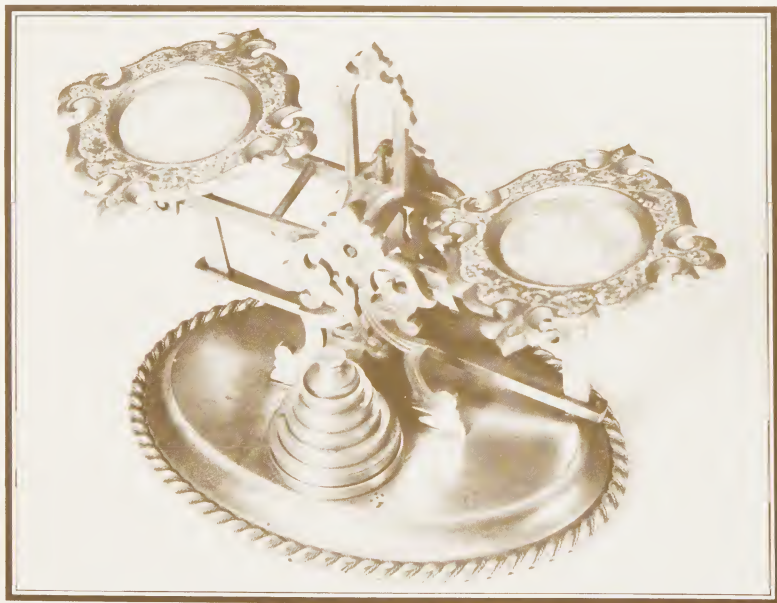


EQUILIBRIUM

QUARTERLY MAGAZINE OF THE INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

1984 — ISSUE NO.3

PAGES 681-708



PAGE 682

Cover Picture

This beautiful English postal scale was made during the 19th century, to weigh letters in a private house. The whole scale and its weights are gilded with a matt finish, to enhance the pretty blue and white Wedgwood plaques in the pans. The left plaque shows Cupid dallying with two nymphs, and the right plaque shows Cupid shooting an arrow while a nymph watches him. The blued steel pointer has snapped off - a minute defect on an otherwise perfect object. The weights for 2, 1, 2/3, 1/2, 1/3 and 1/4 oz prove that the scale was made while the postal arrangement with France was in force, between 1869 and 1875.

The scale is not named, but the connoisseur will immediately recognise all the characteristics of S.Mordan & Co. and admire the fine cord twist between the larger strands of cabling around the base. The intricate engraving is one of many variations cut during this prolific period of ornate postal scales - a period apparently unique to Victorian England.

The Editor thanks Lou uit den Boogaard for his superb photograph.

OBITUARY

We were sorry to hear that Tom Graham died a few weeks ago. We were fortunate to have, in our society, an author well respected for his contributions to W & M literature. Many members will own his booklets 'Scales and Balances' and 'Weights and Measures'. Tom was also the Editor of the W & M professional magazine, Monthly Review, for several years, and was a senior officer in a large W & M department. He wrote about consumer affairs and legal matters, as well as contributing to Equilibrium.

INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

Founded September, 1976

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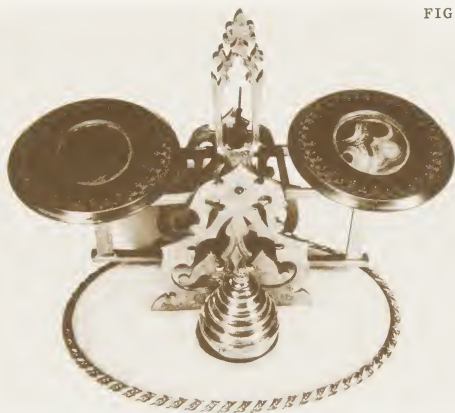
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Authenticity

LOU UIT DEN BOOGAARD

CHECKING ENGLISH POSTAL SCALES & WEIGHTS

As a specialised collector of English postal scales, I would like to offer some advice to people interested in collecting such scales. I have found that most dealers are unable to give assistance, as they sell so many hundreds of different items that they cannot assess completeness, rarity or even genuineness.

Reproduction postal scales are common in English antique markets, so every collector needs to look carefully at the various genuine models. If the new collector starts with a generalised range of postals, he can later select a special maker or a particular type to collect.

Some of the earliest English postal scales, such as candlesticks and hanging spring scales, had no weights, so the collector has no problems there about the possible marriage of weights and scales, but he might find replaced springs of the wrong strength (e.g. 1 lb spring in a 4 oz tube). If he carries a 1 oz and a 2 oz avoirdupois weight in his pocket, he can try the spring out very simply, before buying.

Spring scales have occasionally had the pointer pulled off, but replacement is so easy that it is no deterrent to the collector. However, loss of the top pan is much more serious. Also serious, is the replacement of the pan by some fancy escutcheon, usually held on by a screw. The original top pans were held on by a very flat, slightly domed rivet of matching coloured brass. A few restorers have the facilities to cope with this awkward loss,

so the enthusiast may be tempted to buy an incomplete scale with a beautiful base, fine contrasting bands of chemically coloured brass, and precisely dateable postage rates, in the hope that it can be adequately restored.

The rarer type of postal scale, without loose weights, has a sliding weight on a steelyard arm, but this type is difficult to find. If found, it can be tested by the collector with the weights in his pocket, to assess whether the sliding weight is the original. If it is wrong, he must not expect to find a stray original. The designs were so varied and the weights so different; please reject the scale.*

If the letter hanger is missing, or is the wrong colour of brass, discuss a price adjustment with the dealer, who may not have recognised that the scale is incomplete.

This also applies to pendulum scales, as the delicate letter clip has frequently been lost. Little blued steel or brass clips can be replaced without spoiling all the aesthetically pleasing features of the scale itself. Usually, the box is missing from pendulum scales, so if the collector finds one in its box he must expect the price to be substantially higher, reflecting the greater appeal of gilding, brass or nickel when laid on a bed of velvet or silk.

The largest range of English postals is roberval scales, with two pans or plates above the beam, and a stack of weights at the front. Here is the commonest problem for collectors, because the weights are very often wrong. Now, what weights are correct? Let us start with the most common:-

4 oz, 2 oz, 1 oz, $\frac{1}{2}$ oz, $\frac{1}{4}$ oz	(note that there are two
or 2 oz, 1 oz, $\frac{1}{2}$ oz, $\frac{1}{4}$ oz, $\frac{1}{8}$ oz	of the smallest size.)

More attractive sets have the postage rates marked:-

<u>4 oz</u>	<u>2 oz</u>	<u>1 oz</u>	<u>$\frac{1}{2}$ oz</u>	or	8 P, 4 P, 2 P, 1 P
8 P	4 P	2P	1 P		

'P' was 'one Postage, the unit of payment used by the Post Office from 1840 until 1871, clearly indicating that the weights were made during the earliest period of the Penny Post. Another sequence was:-

4 oz, 2 oz, 1 oz, $\frac{1}{2}$ oz, F, F

The weights marked 'F' weighed $\frac{1}{4}$ oz, and stood for Foreign or France. They were used until 1869 for letters going overseas via France. Also, there was:

4 oz, 2 oz, 1 oz, $\frac{2}{3}$ oz, $\frac{1}{2}$ oz, $\frac{1}{3}$ oz, $\frac{1}{4}$ oz



** There is a disadvantage to this council of perfection. By rejecting an incomplete scale, you may lose a rare and unusual variation or important evidence - a dilemma, indeed. My advice is to buy the incomplete scale if it is unusual or attractive; you are unlikely to get another chance!*

Editor.

This sequence was used during the Postal arrangement with France between 1869 and 1875, when 2/3oz was roughly equivalent to the 15 gram French rate and 1/3oz to the 7½ gram French rate.

Lists of all these Postal rates are available from ISASC*. They are very helpful in determining the period of those scales or weights that have the postage rates stamped or engraved on the surface.

Merely to have the complete set of numbers is not to say that everything about the weights is correct. Check the uniformity of the engraving or stamping of the numbers, the sequence of the rings around the circumference (usually more on the larger weights) and the colour of the brass. Brass comes in different shades, through reddish, yellowish or whitish hues, but the red colour could be caused if the brass has been cleaned for too long in a chemical cleaner. The second alternative is that the reddish weight does not belong to the series.

The finish on the scales should match that on the weights. If the collector finds a gilded scale, he should find traces of gold in the inaccessible corners of each weight. The same applies to nickel-plated scales; traces of nickel should be clearly visible on the weights. However, the scales which were given a special black patina, sometimes had touches of bright gilding to contrast with the "bronze" finish, (this black finish was greatly admired by the Victorians, and should never be removed). Their matching weights could be black, or black and gold.

Does every weight fit into its hole? Weights should not rattle in the base, or rattle in the larger weight it sits in. Nor should they be too tight a fit in the hole.

Postal weights were made for private use, so check both top and bottom of the weight for inspector's stamps. Inspectors did not stamp weights for private use, so any marks (other than the denomination, postage rate or 'cased') are a cause for suspicion.

Postal scales were, however, used by the General Post Office, and were stamped G.P.O. Most Post Masters jealously guarded their right NOT to have their weights inspected by the W & M, but occasionally the inspector did stamp them.

It is unnecessary to remind you that convex-edged weights were never mixed with flat edged weights, but the top weight in a stack was a different shape from those larger than itself, being either bottle-shaped or convex-domed.

The engraving, the colour and the fit in the hole will be the check on authenticity for top weights.

The ability to spot authenticity can be taught, up to a point, but nothing can replace the experience gained by looking at photographs and handling scales and weights, in other people's collections and for sale. So, go out and feel! and enjoy!

* Published in *The Handbook of Old Weighing Instruments*, 1984.



FIG 2.



FIG 3.



FIG 4.



FIG 5.

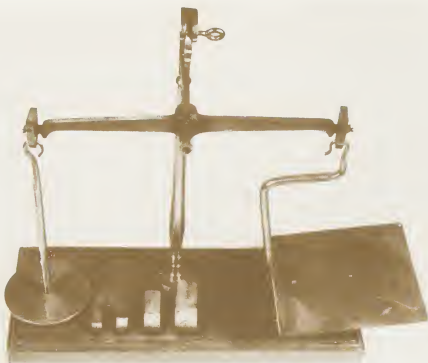


FIG 6.



FIG 6a.

FIG 1. (page 683.) This beautiful letter balance is mounted on an alabaster base with a rim in the form of a decorated rope. The bronze engraved plates are inlaid with malachite and all metal parts are gilded. The gilded weights are 4, 2, 1, 2/3, 1/2, 1/2 oz, but postage rates for 1871 to 1897 are marked in the cup for the weights.

FIG 2. Steelyard postal scale by S.Mordan & Co. with sliding weight. Graduated 0 - 8oz, postage rates for 1871 - 1897.

FIG 3. Ratcliff 'candlestick' balance weighing 1/2 to 16oz. 1 to 32 pence. Postage rates for 1840 - 1865.

FIG 4. Traveller's letter balance by S.Mordan & Co. The left plate is pre-weighted to 1/2oz, so that it will not balance without letters. Letter rates in Postages for the period 1840 - 1871.

FIG 5. Cube-shaped knobbed weights marked 4oz/8P, 2oz/4P, 1oz/2P, 1/2oz/P. P refers to Postages used from 1840 - 1871.

FIGS 6 & 6a. A G.P.O. letter balance with square weights marked GPO and 4, 2, 1 & 1/2oz, originally the property of the General Post Office.

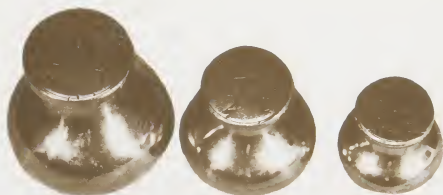


FIG 7.



FIG 8.



FIG 8a.

FIG 7. Bottle weights marked 8oz/3D 4oz/2D 2oz/1½D. D was for the old penny. Postage rates are for the period 1923 - 1940.

FIGS 8 & 8a. Letter balance by S.Mordan & Co. with engraved plates and a rare form of engraving on the weights. The weights are marked only in Postages, 8,4,2,1. The F on the ¼oz weights stood for Foreign or France, for mail going overseas.

FIGS 9 & 9a. A simple scale by S.Mordan & Co. with a set of weights 4,2,1,2/3,1/2,1/3,1/4oz. Postage rates for 1869 - 1875

FIG 9. (top)

FIG 9a (below)



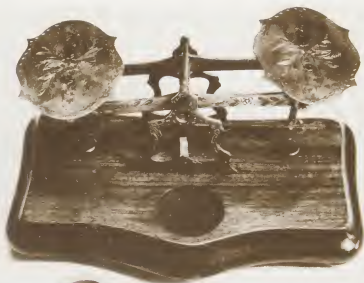


FIG 10.



FIG 11.

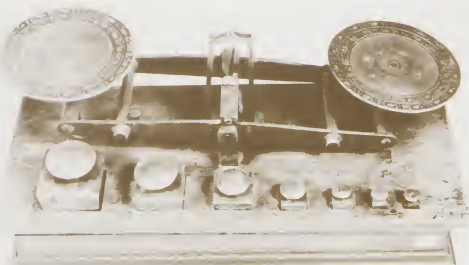


FIG 12.

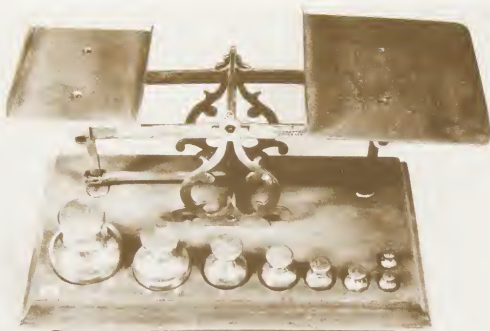


FIG 13.



FIG 13a.

Fig 10. Another engraved scale by S.Mordan & Co.. Only one weight is original, marked 2oz 4P. The other weights were for trade use as is shown by the inspector's stamps. Such weights should not be on a private postal scale.

FIG 11. This scale, by S.Mordan & Co. has four original weights, but the two smaller ones are replacements taken from a trade scale.

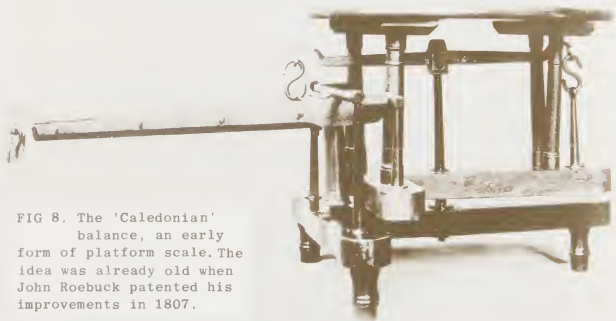
FIG 12. Letter balance by J.& E.Ratcliff, with unusual marking of postage rates around the circumference of the plates, 1840 - 1865.

FIGS 13 & 13a Postal balance without a maker's name, and having a fine set of matching bottle weights 1lb, 8, 4, 2, 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$ oz. The design characteristics are typical of Samuel Turner Snr. Identification can sometimes be made by the shape of the 'A' frame supporting the beam (see page 708. Editor).

Early Platform Scales

Part 2

MICHAEL CRAWFORTH



Courtesy Science Museum, London.

The increasing use of platform scales led to various developments in design and construction. In 1796, William Whitmore, a scalemaker of Birmingham, took out patent No.2079 for an improvement to "*..machines or engines for weighing waggons or other carriages as well as goods or wares of any kind whatever.*" His improvement was the immersion of weighbridge bearings in oil boxes, to prevent rust corrosion, and it was said to be "*...in many instances applicable to old engines already erected.*"

In the same year, 1796, Robert Salmon of Woburn was granted patent No.2095, for his "*...improvements in the general construction of certain machines for the purpose of weighing any kind of goods, merchandise, carriages, waggons, etc....*" Salmon's idea was to connect the weighbridge lever to a resistant consisting of a fusee cam and suspended weight. A dial attached to the cam, rotated with it and, in combination with an index pointer, this provided the first self-indicating platform scale. Among Salmon's other ideas, was the use of a sub-frame and removable platform to facilitate easy installation, adjustment and replacement.

Development of platform scales was slow by modern standards. According to Benton (4), it was not until after Wyatt's death, in 1760, that other weighbridge makers started using modified forms of his scale, in which the lever was attached to the short arm of a steelyard, in the modern style. To do this, they had to change the lever from a first order lever to a second order lever, to reverse the direction of movement from Wyatt's

'bob-up' design to a downward pull. The only documentary evidence of this adaptation, so far discovered, is the entry under "STEELYARD" in the 3rd edition of the Encyclopaedia Britannica 1797, in which platform scales are described in some detail:

STEELYARD.

"The chief use that is now made of the steelyard in these kingdoms is for the weighing of loaded waggons and carts." "The most compendious and economical machine of this kind that we have seen is one, first used (we have heard) for weighing the riders of race-horses, and afterwards applied to the more reputable service of weighing loaded carriages."

"Fig 6, is a plan of the machine. KLMN is the plan of a rectangular box which has a platform lid or cover, of size sufficient for placing the wheels of a cart or waggon. The box is about a foot deep, and is sunk into the ground till the platform-cover is even with the surface."

The article goes on to describe the arrangement of levers shown in Fig 9, and adds:-

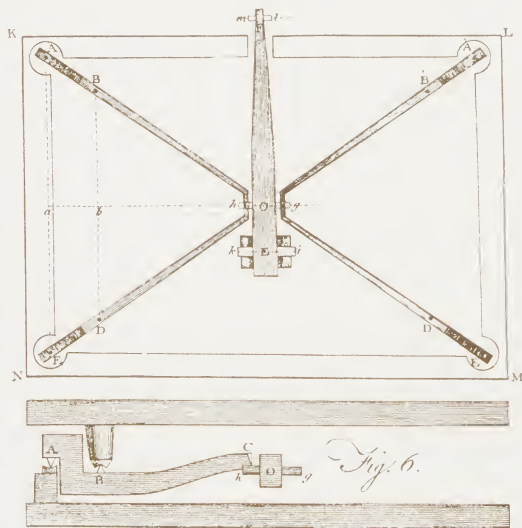


FIG 9. This figure from the Encyclopaedia Britannica of 1797, shows Wyatt's VV lever arrangement modified by making the transfer lever pull downwards on the end of a steelyard or weighbeam (not shown).

"If there now be placed a balance or steelyard at the side LK, in such a manner that one end of it may be directly above the pin 'lm' in the end of the lever EOF, they may be connected by a wire or slender rod, and a weight on the other arm of the balance or steelyard may be put in equilibrio with any load that can be laid on the platform."

*"The simplest and most economical form of this machine is to have no balance or second steelyard, but to make the first steelyard EOF a lever of the first kind, viz. having the fulcrum between O and F, and allow it to project far beyond the box. The long or outward arm of this lever is then divided into a scale of weights, commencing at the side of the box. A counterpoise is then chosen, such as will, when at the beginning of the scale, balance the smallest load that will be examined."
"It will be convenient to carry on this scale by means of eke-weights hung on the extremity of the lever, and to use but one moveable weight."*

Eke weights were proportional weights suspended from the end of the beam, as with the modern 'loose-weight steelyard'. The earlier reference to a steelyard being placed over the end of the platform lever, and connected to it by a wire or slender rod, infers the use of a pillar to support the steelyard at a convenient height for use. Such pillars are known to have been used for other types of weighbeam on platform scales. This evidence is important in the light of later developments.

Trade and industry were not alone in benefitting from the invention of the platform weighing machine. Doctors, clubs, and private individuals could obtain platform person scales made in the late 1700's. Several examples are extant, and they are the only platform scales known to have survived from the 18th century. They were elegant mahogany cased machines bearing the signature of Weeks c1790, and Merlin 1760-1803. Another type of seat platform machine was signed by Haas, who worked in London from c1777 to 1800. ▷

FIG 10. Elegant person scales, like this one by Thomas Weeks, were made in the late 18th C. A rule slides up the front of the column to measure height. Wooden trays supported the pan and weights (missing).



Person scales by Weeks, Fig 10, had a combination of one Y and one V shaped lever below the platform, with the tail of the Y connected to a small unequal-arm swan-neck beam, mounted at the top of a wooden pillar, (the YV arrangement). They are the earliest known surviving examples of the use of conventional weighbeams connected to the platform mechanism via a transfer lever and rod link, but the idea had probably been used for some decades before Weeks machines were made. This system permitted the beam to be placed at a convenient height for the user. Some of Weeks' scales had a suspended pan for proportional nesting weights; others had a hanger for proportional slotted weights - an early example of this type. Merlin's scales appear to have been very similar in design, certainly in their external appearance. Similar scales were made throughout the 19th C.

A most unusual platform person scale signed '*I.B.Haas, Londini, Fecit, No. 41002, John Trotter Esqr. Soho, London, Inv.*' dates from the end of the 18th century. Jacob B.Haas came from Swabia and started a business making scientific instruments in London, while Trotter was an upholder (maker of upholstered furniture). In Trotter's design there were two rocker beams similar in principle, to those later used by Fairbanks. A steelyard beam was attached directly to one of the rocker beams, thus making one of the most simple platform mechanisms, Fig 14. This is the the earliest known surviving example of a steelyard beam with a platform scale. Haas used cone-and-cup bearings, and, in common with other known compound lever platform scales of the 18th century, the manner of interconnecting the levers caused the bearings to rub sideways, resulting in extra wear and friction. He provided loose slotted weights for a maximum capacity of 24 units (presumably stones), including the 14 lb graduations on the steelyard blade. Troy graduations were also marked, up to 17 lb, along the blade. Accurate reading was assured by the vernier scale marked on the sliding weight.

Were person scales, such as these, used to weigh jockeys BEFORE Wyatt made his weighbridge, as suggested in 1797 by the author of the article in Encyclopaedia Britannica ? ▷

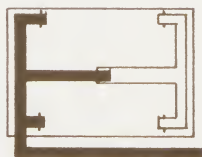
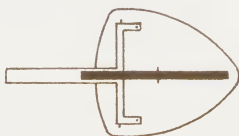


FIG 11. Weeks' YV lever arrangement for person scales.

FIG 12. The IT arrangement used for the Caledonian balance.

FIG 13. An FT layout was used by Trotter in his scale made by Haas.

These drawings are not to scale, but show in a very simplified form, the schematic arrangement of the levers.

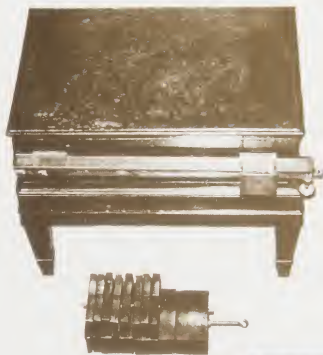
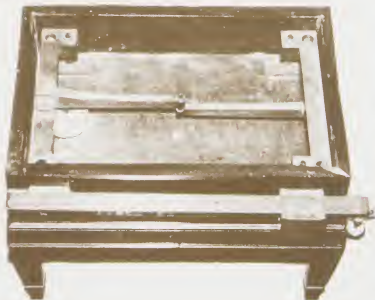


FIG 14. Attractive in its simple elegance, this platform scale was invented by John Trotter and made by Jacob Haas. It has the steelyard blade neatly placed along the front edge. Various loose rectangular brass weights were suspended on a hanger from the end of the blade. The steelyard is marked "Troy Pounds & Ounces / Avoirdupoise" and is graduated 0 to 18 lbs and 0 to 15 lbs. Date 1790's.

Courtesy Science Museum, London.

Photos by Dr.G.L'E Turner.

FIG 15. With the platform removed, the FT levers are revealed resting on their cone and cup pivots. The top stroke of the 'F' is the steelyard blade. A round adjustment weight is fixed below one of the levers. The frame and platform are polished mahogany 457mm x 302mm x 362mm high. (18" x 12" x 14.3").



Further evidence for the early manufacture of platform scales appears in contemporary advertisements, but much research remains to be done. Broadbent (7) found "Ford & Co. Weighing Machine Makers" in a Birmingham directory of 1777, but in general, it was not until the 1820's that a special point was made of advertising them in directories. It was during that decade that illustrated advertisements for scales first appeared, and we find, for example, Bourne & Smith of Birmingham making "*Patent and Improved weighing machines of all sizes to weigh from loz to 5 tons*" in 1829; W.C.Day of Birmingham advertising "*Weighbridges made upon the best principles for heavy goods, live cattle and road waggons*" in 1829; and, in the same year, Thomas Bourne illustrated his "*contracting machine*" - a platform scale with a pillar and hanging pan, Fig 16. In the 18th century, the term 'weighing machine' referred specifically to compound lever

MOUNT STREET WEIGHING MACHINE MANUFACTORY.
At this Establishment

every Description of Weighing Machines, Scale-Beams, Steelyards, Scales, Tare Plates, Die Stocks, Weights, &c. &c. are Manufactured in the first style, of the best Materials & on the most approved principle; by

THOMAS BOURNE,

"observe"

MOUNT STREET.

Birmingham.

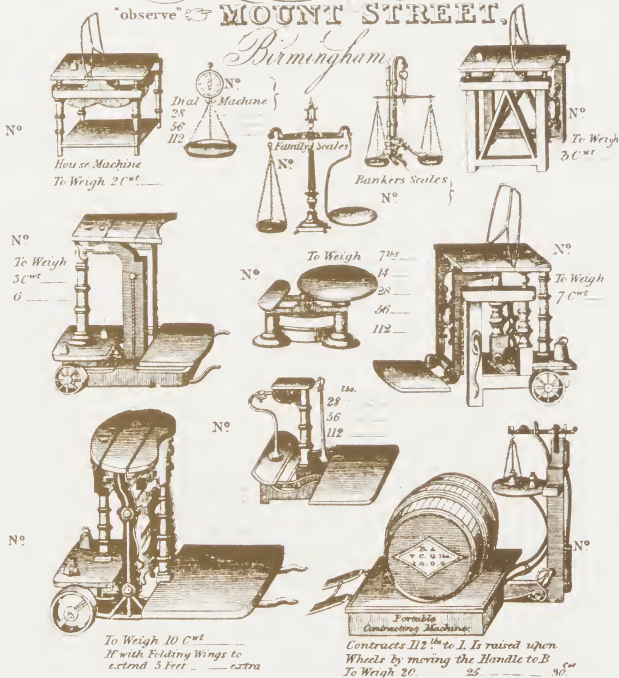


FIG 16. This advertisement from Wrightson's Directory of Birmingham, 1829, shows Thomas Bourne's platform scale (bottom right) with its unequal-arm beam and bell weights. Note the relieving gear.

platform scales, but in the 19th century, the term seems to have included Roberval and inverted roberval machines, too. A contracting machine reduced the size of weights required, that is, it used proportional weights with a contracting ratio (lever ratio) of some convenient figure, like 112 to 1. (One hundredweight was 112 pounds).

In 1807, John Roebuck, a civil engineer of St.Pancras, London, took out patent No.3044 for "*Certain improvements in a Machine called the Caledonian Balance.*" Fig 8. This machine, which, by its name, appears to have been Scottish in origin, was a form of platform scale. When a load was placed on the oval platform, three legs under the platform pushed down on a 'T' shaped frame. This pulled down the rear end of a swan-neck beam and pulled up the front end of the swan neck beam which was attached to a steelyard. The frame also pulled down the rear end of the steelyard in synchronisation. Loose weights were suspended from a double hook at the end of the steelyard blade, until the load was nearly balanced, and then a movable poise was hung on one of seven smaller hooks projecting at equal intervals along both sides of the steelyard blade. So, the Caledonian balance was a platform scale with three-point suspension and a loose-weight steelyard. The levers had an 'IT' arrangement. The swan-neck beam was used purely as a transfer lever, (the 'I') and not as a weighbeam.

Roebuck's improvements included the use of alternative weighing elements: a spring balance; a pendulum; or a pan and weights, in place of the steelyard. No examples of these are known to the author, but several examples of the Caledonian balance are extant. Clearly, the design predates 1807, possibly by many years. Without further evidence, it is impossible to say whether, or not, it predates Wyatt's invention. The Caledonian Balance is sometimes described as a person scale, due, probably, to its likeness to a stool. However, Roebuck's patent shows what appears to be a lump of meat on the platform, which would indicate its purpose as an early form of counter platform scale.

The earliest extant weighbridge, known to the author, is the barge weigher now located at the British Waterways Museum at Stoke Bruerne, near Towcester. This machine was originally built for the Glamorganshire Canal in 1836, by Brown, Lenox & Co. Fig 18. The design has the Wyatt 'VV' system of levers connected to the weighbeam, but in place of an over-beam platform, there is a suspended framework hanging below water level in the canal lock. The barge, or 'long-boat', was sailed over the frame then the water was drained from the lock, leaving the boat suspended from the weighing machine. The weight of the load was ascertained by subtracting the tare weight, previously obtained for the empty boat. This Brown, Lenox weighbridge is clearly a direct descendant of Wyatt's design and bears no resemblance to other earlier British or foreign designs. Its bold simple forms show the maturity of design of a well established platform-scale industry.

Part 3 of this article will appear in a later issue of EQM.

FIG 17. Six slender columns support the VV lever system of this marvellous early platform scale, making all parts readily visible. The weighbeam slopes from the centre of the VV's to the right.



FIG 17.

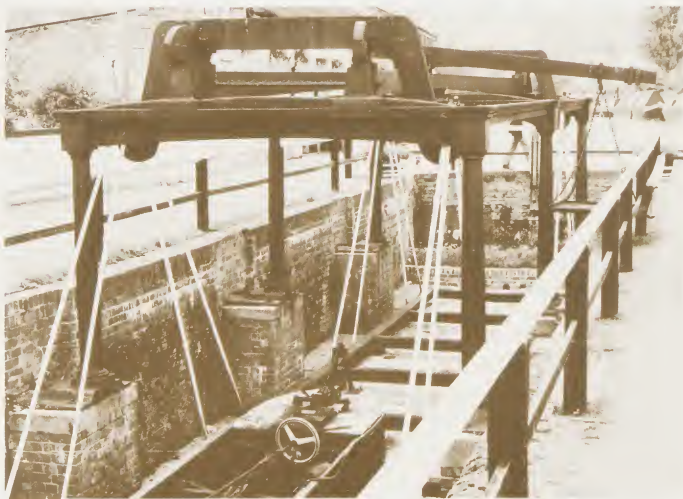


FIG 18. The tray for the weights hangs by chains from the weighbeam at the right. A small barge rests on the weighing frame which hangs freely, by white bars, from the  girders pivotted on top of the VV's.

Courtesy British Waterways Museum, Stoke Bruerne.

Precision Balance 7

HANS JENEMANN

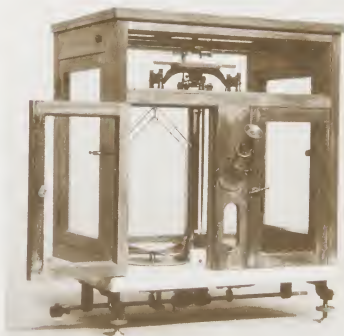
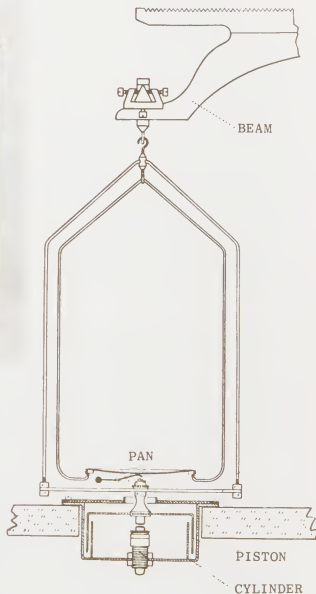


FIG 1. Bunge's aperiodic balance.

FIG 2. (right) Bunge's damping arrangement below the pan.

This short beam balance, Fig 1, was made by Paul Bunge's firm, c1925. It was designed for a maximum load of 200g and has a sensitivity of 0.1mg. Observation of the pointer deflection is by the microscope projecting from the front of the case. The 130mm beam is brass, coated with 'Zapon', an anti-corrosion lacquer. The top of the beam is straight and extended at the ends to carry a rider weight. The rider travels the full length of the beam from 0 on the left to 100mg on the right, providing greater accuracy than other types which travelled over only half the beam length. Notches in the top of the beam provide accurate, and repeatable, location for the rider. The glass and mahogany case is 430mm high (16.9").



The balance is provided with air-damping to reduce the number of oscillations, and to speed-up weighing. Damping is produced by a cup-shaped piston, attached below each pan, moving inside a cylindrical box set into the base of the case, Fig 2. The piston never touches the side of the cylinder, but the gap between them is very small, so air escapes

past the piston only very slowly. This slight air resistance causes the beam to come to rest very quickly with aperiodic oscillations. (Balances with damping are thus called 'aperiodic balances'). The effectiveness of this system can be seen in Fig 4, where the aperiodic curve (2) is shown coming to rest after about six swings, while the nearly periodic curve of the undamped balance (1) is likely to continue swinging for many minutes. Thus, on the damped balance, one reads, directly, the position of the pointer, instead of using the tedious 'deflection method' (described in Precision Balance 3, EQM p589).

It is important to note that the accuracy and sensitivity of the balance is NOT affected by damping. Balance users found this difficult to believe, and it was half a century before damped balances were accepted for general use in laboratories. ➤

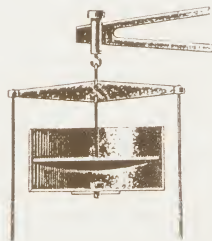
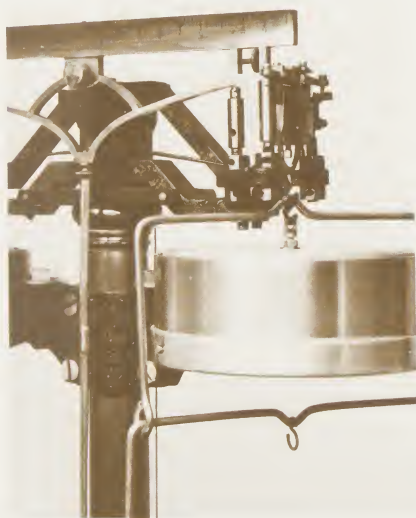


FIG 3. (above) Air damping by F.Sartorius, Gottingen, 1930, comprises two cylinders, one below each end of the beam. This arrangement became popular.

FIG 4. (top right) Curves showing the oscillation, or swinging of the beam. Each curve above, or below the centre line, represents a swing of the beam. (1) Undamped beam. (2) Damped beam.

FIG 5. (bottom right) Arzberger's single damping cylinder with a disc-shaped piston 'd', 1875. The cylinder is fixed to the column or case, by a bracket (not shown).

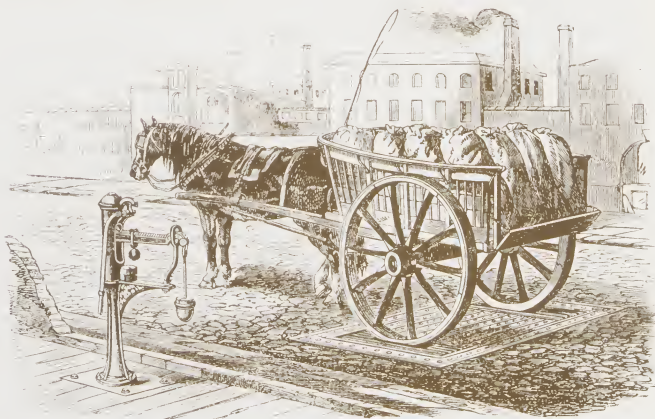
The first person to construct an air-damped balance, was Friedrich Arzberger, in Vienna, in 1875. At that time, he was Director of the Imperial and Royal Standardisation Committee of Austria, and later became professor of mechanical Technology. Arzberger fitted one damping cylinder below a hook at the end of the beam, Fig 5, but this idea was only used for a few high precision balances. After 1930, air damping devices became popular and they were installed in different parts of the balance: above, below, behind or at the side of the beam, or combined with the pointer. The most common arrangement used two cylinders, one below each hook, thus doubling-up Arzberger's original system, Fig 3. One disadvantage of this arrangement was that there was less space above the pans for weighing voluminous vessels.

In 1889, Pierre and Marie Curie, well known for their work on radioactivity, constructed an air-damping arrangement with two cylinders in the base of the balance. This system was used by A.Collot of Paris and later by C.Becker in the Netherlands and P.Bunge of Hamburg. Bunge's design is shown in Fig 2.

After the introduction of the, so-called, single-arm substitution balance, by E.Mettler in Switzerland after World War II, air damping changed again. In his H series balance, made from 1957, the piston disc was attached directly to the rear end of the beam, and so Arzberger's idea of air-damping with one cylinder had a happy revival.

Old Advert

From the Pooley & Son catalogue 1859.



CART WEIGHBRIDGE.

Notes & Queries

NQ 73 AE - WAGE (NQ 73)

reply from Jan Wage.

If it is of any help to your readers: DRGM denotes 'Deutsches Reichsgebrauchsmuster' (Industrial Design Patent); DRP denotes 'Deutsches Reichspatent' (Technical Patent); A denotes 'Angemeldet' (Request Deposited, i.e. Patent Pending). In view of these indications it would seem reasonable to assume that A.E. is the scale manufacturer's name, otherwise patent or design protection would be nil and of no value.

Perhaps some German colleague knows more about the existence of this mysterious Mr.A.E.WAGE ? He is not an ancestor of mine, anyhow!

NQ 74 LETTER SCALE MARKED S.O.

query from Bob Holdaway.

Please can you advise me on the enclosed photo which shows a Salter scale marked S crown O ? Do you consider this is a private or personal letter scale, or an official Post Office scale? At first sight, I would say the former, but then the S.O. makes me wonder if it was Crown property.

REPLY from the Editor

This type of scale was normally for private or commercial office use, but there are a few around which have the S.O. mark. It seems that the Stationary Office (S.O.) of H.M.Government had scales marked in this way to denote Crown property. The scales were issued to any Government department which needed to weigh letters. Income Tax offices are a typical example.

Right: Bob Holdaway's Salter letter scale marked S  O The capacity is 0 - 8oz, with postage rates for the period 1897 to 1915.



Patent Postals

MICHAEL CRAWFORTH

A SURVEY OF POSTAL SCALES PATENTED IN BRITAIN, 1840 to 1940



FIG 86. Pocket letter scale
by the Exact Weight
Scale Co, U.S.A.

1932 29 Jul. No. 402539. E.SCHNECKENBERG

See Fig 89.

A fountain pen or propelling pencil is provided with storage space for a number of knife-edged parts which may be assembled to form a beam scale, utilizing parts of the pencil or its protective cap.

Various parts of the instrument are shown in the drawing. In one example, the lead-propelling rod is extended to form a bismar, the body of the pencil being the weight. A wire hook is used to suspend the letter from the end of the rod, and a knife-edged bar is placed in one of the graduated notches under the propelling rod. A similar method is adopted for the lower pencil in the drawing, where the graduated notches are in the body of the pencil, so eliminating the need to dismantle the instrument. No examples have been seen by the author.

1933 9 Jan. No. 411206. B.E.WEERASINGHE & J.BANKS

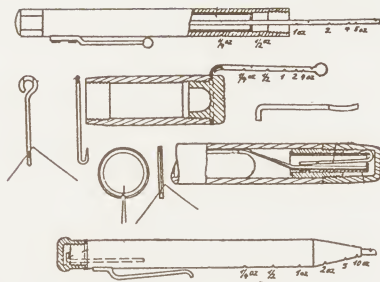
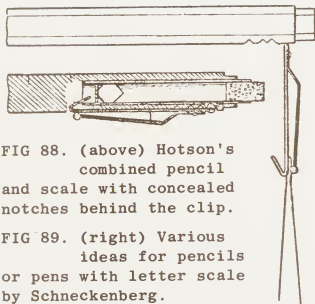
See Fig 87.

A flat bar has six notches underneath the centre, and a weight fixed to one end. Near the other end is a recess for the letter. One edge is divided to make a rule and straight edge.

The abridged specification makes no reference to the precise method of use, merely that there is "...a recess for correctly positioning the article by the finger" (Any guesses as to how this was done?). Presumably, a paper-knife was placed on edge in the appropriate notch to form the fulcrum. No example has been seen by the author.

FIG 87. Weighing rule patented by
Weerasinghe & Banks. How
was the letter recess used?





1933 16 Nov. No. 424548. P.WERTHEIM

See Fig 90.

A combined paperknife and letter balance has a turned down end on the handle for the suspension of a letter clip. A sliding cursor, or saddle, with a knife edged foot, slides along graduations on the handle. Alternatively, the pivot may be fixed to the handle, and the cursor used as a sliding weight.

Another combination instrument, this time designed on reasonably practical principles. No example has been seen by the author.

1935 4 Sep. No. 453128. F.JURIS

See Fig 91.

A fountain pen or propelling pencil has a screw end to hold the letter. The pocket clip is used to suspend the instrument from a sliding cursor, or saddle, which moves along the cap. Two sets of graduations are provided, one for the pen full of ink, the other empty. Sloping lines drawn between the graduations allow for intermediate quantities of ink.

Apparently, the letter was simply trapped between the screw and the cap - not a very satisfactory method, if the letter was stiff, because the centre of gravity would shift according to the angle of tilt. The sloping lines of the graduations are theoretically satisfactory, but are they practical? Would the user remember to look at the end of the line appropriate to the amount of ink left, or would he look at the nearest figure? No example has been seen by the author.

1935 26 Jan. No. 453328. EXACT WEIGHT SCALE Co.

See Fig 92.

A pocket spring letter balance has the appearance of a fountain pen. On the removal of the cap, a spring letter clip is exposed, attached to a graduated slide. A screw knob at the other end of the body is used to adjust the scale to zero.

This is a thoroughly practical little balance, Fig 86, made in America by patentees, in green and black plastic. Similar balances were made in England, in mock tortoise-shell, by Geo.Salter & Co.

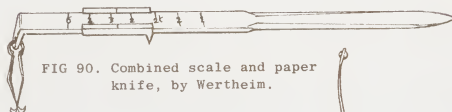


FIG 90. Combined scale and paper knife, by Wertheim.

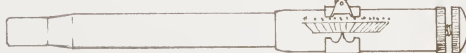


FIG 91. Screw letter holder on Juris' pen/scale.



FIG 92. Zero adjustment was a feature of the Exact Weight Scale Co.'s scale.

1936 26 May No. 463225. WEINTRAUD & CO.GES.

See Fig 94.

A pendulum letter scale has a top plate and half-roberval mechanism. A loose weight fitted to the pendulum, when required, increases the weighing range.

The bow-front design of this little scale is deceptively like a spring balance. In the example illustrated, Fig 95, the two weight ranges are 0 to 4oz x $\frac{1}{2}$ oz and 4 to 9oz x $\frac{1}{2}$ oz.

1937 27 Feb. No. 491380. C.RULKE

See Fig 96.

A letter balance is formed from a flat strip of metal bent to form a fulcrum near one end. A letter clip is pivotted from the end. In an alternative design, several fulcra may be made, to weigh different values. The other end of the strip may be formed into a paper-knife.

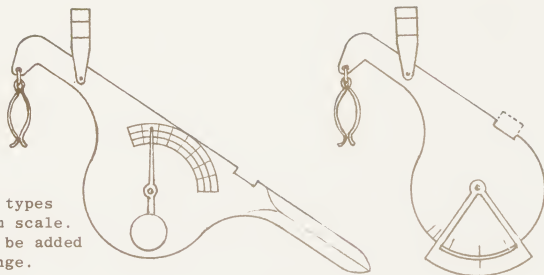
This is another very elementary combination tool. In its simplest form only one weight can be tested. No example has been seen by the author.

1937 24 Apr. No. 494271. J.H.HOTSON

See Fig 88.

A combined pen or pencil and letter balance has notches near one end for the fulcra. The pocket clip is double-sided and can be released from the body by pulling out the tube holding the india rubber. The clip then forms a suspension device for the letter.

FIG 93. Rowe's two types
of pendulum scale.
A loose weight can be added
to increase the range.



The notches in this instrument are cleverly concealed by the pocket/letter clip when it is in the closed position. Again, it must be assumed that a pocket knife is available to form a pivot. No example has been seen by the author.

1937 1 Dec. No. 506650. A.G. ROWE

See Fig 93.

A pendulum balance has a disc-shaped body-part carrying a pendulous pointer and graduated arc. A letter clip and suspension shears are attached to an extended neck, and a weight projects in the opposite direction. In an alternative design, the weight projection is omitted and a pendulous weight arc is suspended from the centre pin. In each case, a loose weight can be added to a notch in the top, to increase the weighing range.

These two ideas revive Hall's ideas of 1863 (See EQM p428), but they miss the original elegance of design, and add no useful features except, perhaps, the increased weighing range. No examples have been seen by the author.

FIG 94. (below) Weintraud's bow-front
pendulum scale, showing the
loose weight attached to the pendulum
weight, for the high weighing range.

FIG 95. (right) The loose weight in
its stored position at the
back of the case. Brass metalwork
chromium plated.

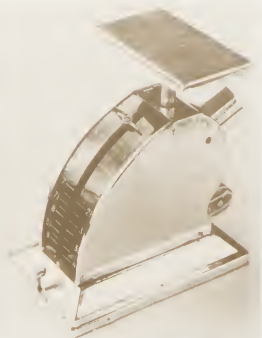
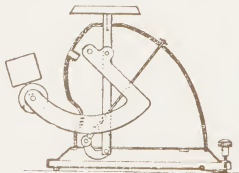




FIG 96. Rulke's simple bent-strip scale and paperknife.

In concluding this series, it is interesting to observe that inventive postal scale design is still with us. Today, spring, pendulum, hydraulic and electronic letter scales are available, and, in Germany, a clever little plastic scale with an opposed magnet resistant, can be obtained, (See EQM p260). Will the escalating cost of postage inspire further clever inventions ?

The dating of postal scales by patents, has already been discussed in the introduction to this series. Even when a scale is not marked with the patent number, it is sometimes possible to identify it by comparison with a patent description or drawing. Research into other means of identifying anonymous letter scales is mentioned below.

Identifying Letter Scales

'A' frames are an important visual element in the design of roberval letter scales. Their central position, supporting the beams, and their decorative style, catch the eye. This was recognised by the makers, and they used many varied designs. Michael Robinson's research into this subject is beginning to reveal characteristic shapes for particular makers. His research would be extended enormously, with the help of ISASC members. If you have English roberval letter scales, please would you spend a few minutes recording the A-frame shape; hold a piece of white card against the A-frame and trace around the shape with a sharp pencil. Send the drawing (and a note of the maker's name, if there is one) to Michael Robinson, Hiraethog, Eglwysbach, Nr. Colwyn Bay, Clwyd, North Wales, United Kingdom. When Michael receives the drawings, he will fill around the lines with black ink to make the impressive records shown below (Shown here in reduced size).





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PAGES 709-736



PAGE 710

Editor's Comment

In the Summer 1979 issue of EQM (pl37), John Lound gave us an entertaining and detailed account of how an English scale repairer prepared shop scales for official inspection. In this issue, an equally enjoyable and authoritative account of the inspector's role is given by Bob Holdaway. The importance of these contributions cannot be overstated. Without such records these fascinating aspects of our past would be forgotten, perhaps for ever, supplanted by the latest electronic technology. I believe it is a duty, as well as a pleasure, to preserve this knowledge for posterity. PLEASE will members in other countries, write, or persuade others to write, about the manufacture, repair and inspection of scales and weights, in their country.

Cover Picture

This type of gold-painted shop scale became very popular with shop keepers in the 1920's, gleaming smartly on the counter, with reflections shining from the round mirror - very much the newest and smartest fashion. The quick 'self-indicating' read-out covered 0 - 2 lb by $\frac{1}{4}$ oz divisions. It was made for use by confectioners, and bears the label of A.Walker & Co. Ltd. of Newcastle on Tyne. (see the article on page 711).

PLATFORM CONTENTION

The early weighbridge shown in Fig 7, page 660, was Yeoman's version of Eayre's design, so, although Eayre claimed it was a direct copy, we cannot be certain of the details until further evidence comes to light.

INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

Founded September, 1976

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FIG 1. Roberval counter scale.

An Inspector Looks Back

BOB HOLDAWAY

It is only recently that I had the opportunity to read the erudite and descriptive article 'Repairing Sugar Scales' by John Lound (EQM p137). This not only brought back to me nostalgic memories of fifty years ago, when I was a junior assistant in the Weights and Measures department at Crewe, but was the inspiration behind this article. During those trainee days I was given many opportunities to observe, at first hand, the many and varied skills of the old-time mechanic. I still recall with affection, the names of two such craftsmen; Jim Gifford of Avery's and Harry Salisbury of the Crewe Co-operative Friendly Society.

Mr.Gifford, as I respectfully called him, was foreman of Avery's Crewe branch, and many a Thursday evening was spent in his company, when we used to strip down one or more of the latest Avery models - scales of course! - usually of the self-indicating or semi self-indicating variety (loosely called 'automatics' by the uninitiated). These were generally large, heavy, and ornate weighing machines with a dial that young and old, alike, could read with ease. They don't make models like that any more. I then had the task of putting the parts together again, naming the pieces as I did so. This was done on the dining room table behind the shop, under the benign eye of Mrs.Gifford, who would be sitting in the corner of the room getting on with the family chores....Happy memories.

Harry Salisbury was nearer my own age. Avery trained, he worked at John Player's factory at Nottingham, before coming to Crewe to maintain the scales belonging to the Crewe Co-operative Society in their shops in the town and surrounding area. Most of them were beam scales and counter scales, and Mr. Lound's description of heating centres and the consequent immersion in water, vividly takes me back to a little workshop tucked away in the corner of the main Co-op building. On entering the workshop, a privilege in itself, one would be faced with the red glow of burning coke, an old tin of steaming water, whitewashed cob-webbed walls, hooks and nails supporting old beams, stays, legs and pans. A table was full of tools of every description and numerous tins containing knife edges, friction plates, screws

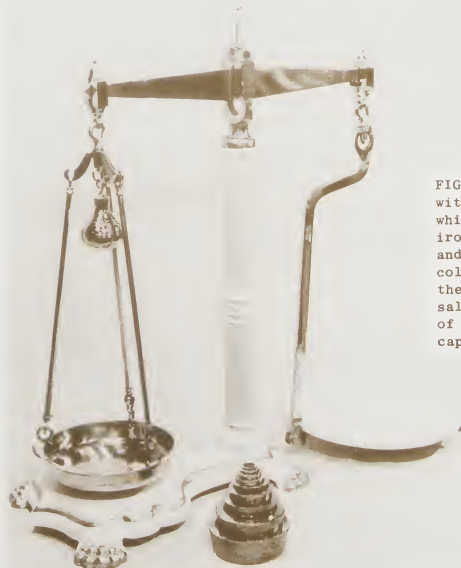


FIG 2. Beam scale with brass fittings, white and gold painted iron 'balloon foot' and a pink porcelain column. Illustrated in the Co-operative Wholesale Society catalogue of 1933, available in capacities 10 to 30 lb.

and colourful agate bearings. Test weights abounded, as all denominations were duplicated. These, including dozens of dram and grain weights, were kept in an adjoining cupboard, away from inquisitive hands. On the bench would be two or three beam scales and counter machines in various stages of repair. This exciting Aladin's cave was only a few hundred yards from the austere Municipal Buildings, and I was there on every occasion I could escape from the dull routine at an office desk.

Harry knew every scale in every Co-op branch in his area. His scales never suffered the indignity of being punched in the face by a steel stamp bearing a star design, or having a label attached to their necks proclaiming they had been 'rejected'. Harry was one jump ahead of all that nonsense, and could spot an ailing scale as soon as he entered a shop. Weights were not his forte, the inspector could reject and punch a star on as many of those as he wished - the responsibility for adjusting such mundane objects was that of the Weights and Measures department. He had his beloved scales to keep in pristine condition, and he had plenty. In those days, even a modest sized Co-op shop would possess probably one or two self-indicating scales, one or two beam scales and a counter machine, together with dozens of iron and brass weights. In the storeroom at the back, would be a 3 cwt. capacity platform machine, another counter machine, a spare beam scale and enamel measures for selling vinegar. Where have they all gone ?

They don't make models like Harry, any more, either...

These two gentlemen were willing, nay eager, to share their knowledge, together with the tricks of the trade, without any thought of reward beyond that of giving a future inspector the practical grounding that proved so valuable in later years. This article gives me a belated opportunity to acknowledge the debt I owe them. I hope I never let them down.

So this, now retired, Inspector of weights and measures started his working life with an inbuilt respect for the skills of the true professional. Indeed, the relationship between an inspector and a scale mechanic was generally a happy one. True, occasionally one came across the odd 'bodger' but he didn't last long, and I expect, on the other side of the coin, there could be found the over-meticulous fault-finding inspector.

Inspectors were guided by the Weights and Measures Regulations and Instructions of 1907, with regard to the construction, strength and suitability for trade purposes of all weighing equipment. Permissible tables of error on testing were laid down for both verification and inspection. The error allowed on verification, that is on the initial testing of a new scale just turned out from the factory, or on a repaired scale, as described by Mr. Lound, is much smaller than that permitted on inspection.

On inspection at a trader's premises, a weighing machine would be tested in situ. A beam scale, counter machine, steelyard or platform machine, had to balance when unloaded. Then, when the beam was loaded, it had to oscillate freely and return to the position of equilibrium when the load was removed. The scale also had to satisfy an error test, and a sensitivity test, at full capacity. The error was described as the weight in excess or deficiency required to bring the beam to a horizontal position when fully loaded. This test determined if the lengths of the arms of the beam were equal on each side of the fulcrum. The greatest error permitted on a 7 lb beam scale was 36 grains.

The sensitivity test was applied with the maximum testing load, with the beam in a horizontal position, to ascertain that it turned with the amount permitted for sensitiveness - again, a maximum of 36 grains for a 7 lb

beam scale. In the case of beam scales and balances, the addition of this amount, to either pan, was required to cause an appreciable movement of the beam.

The tests applied to a counter machine were more complicated. In addition to the error and sensitivity tests when the machine was fully loaded, a test known as the eccentric test was applied. This was done to detect any errors in the legs and stays of the machine which might cause inconsistent weighing, if the load was eccentrically placed on the pan.

If the goods pan was relatively flat (not a scoop), a load equal to half the capacity of the machine was placed on the pan, in one of several positions. Each position was offset from the centre of the pan by a distance equal to one third of the greatest length of the pan. A similar load was applied to the weight pan, and the machine was required to indicate the correct weight, within half the prescribed limits of error. The diagram represents a top view of a counter machine with the position of the loads numbered 1 to 8. There were many tests to be done, as can be seen from the following procedure, Fig 3:-

Place the test load on each pan in positions W and G, to determine the error. Then move the appropriate load to each of the positions indicated and determine the error at each position. i.e. place the loads at 1 and 5, 3 and 5, 3 and 7, 1 and 7. Then test at 2 and 6, 4 and 6, 4 and 8, and 2 and 8. From experience, placing the loads at positions 2 and 8 or 4 and 6, initially, quickly determined whether to proceed with further testing.

This testing procedure applied equally to semi self-indicating counter machines, but, in the case of a self-indicating counter machine, the load was applied in the various positions on the goods pan only. On this type of dial weighing machine, including spring balances, there was no test for sensitivity, but the indicator had to return to the zero mark when the load was removed.

Similar tests were applied to 'dead weight' machines, which, in effect, were large counter machines generally of 2 cwt. capacity, and usually of the accelerating kind rather than the vibrating type. However, the eccentric test was carried out with a load equal to one quarter of the capacity of the machine, instead of half the capacity.

On platform machines and weighbridges, the eccentric test was applied with a load equal to one quarter of the capacity of the machine, placed, not in the positions illustrated above, but in the centre and near each corner of the platform, Fig 4.

Accelerating machines, dead weight machines, platforms or weighbridges were tested for error by ascertaining the weight required just to keep the beam or steelyard indicator in a horizontal position on its stop, or carrier, and no more. They were further tested by ascertaining the weight required to bring back the beam or steelyard indicator from its position of greatest displacement to the horizontal position, the instrument being, at all times, fully loaded and truly balanced. With no load on the pan or platform, the beam or steelyard had to just leave its lower stop and rise steadily to its upper stop.

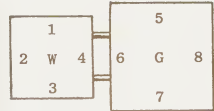


FIG 3. The test weight positions for roberval counter scales.

W = weight plate
G = goods plate

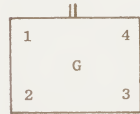


FIG 4. The test weight positions for platform scales & weighbridges.

FIG 5. (left) Semi self-indicating scale by the Automatic Scale Co, Altrincham, Cheshire. The hygienic glass plate was for use by butchers, the capacity 20 lb, with 0 - 1 lb x $\frac{1}{4}$ oz shown on the fan chart. Bell weights 14, 7, 4, 2, 1 lb. Patents 216609 & 224476 (1925)

If a scale failed a test, it was rejected and a star stamp  was placed over the verification mark. A scale thus marked could not be used, under penalty, until it had been repaired, re-tested, and re-stamped.

Traders paid no fee for inspection tests. On his visits, the inspector had to check that, if any scale was found incorrect, it was only due to fair wear and tear, and not due to unjust manipulation nor due to the addition of extraneous material.

On verification, a fee was payable, whether the scale was duly passed and re-stamped, or not. That, in itself, behoved the mechanic to make a good job of repairs. He wouldn't be very popular with his employer if he had to

spend another three hours or so doing the repairs again. The trader, when he got his scale back re-stamped, knew that whatever the repair charge had been, he had, at least, got a guaranteed job that would last him another twelve months, and probably longer. This rather unique arrangement, whereby a local authority officer supervised the workmanship of an employee of a commercial firm, was consequent to the sensible 'Use for Trade' aspect and the need to protect a consumer from fraud. Those of us who have had unhappy experiences regarding repairs to cars, television sets, washing machines, and so on, would no doubt, settle for a similar arrangement.

Scales requiring verifying, and hopefully, stamping, were either submitted to the inspector at his office, or, if there were a sufficient number, stamped by the inspector at the scalemaker's premises.

Tolerances on verification were more stringent than on inspection. On the 7 lb beam scale, for example, the error allowed was a maximum of 18 grains, as against 36 grains on inspection, and the sensitivity allowance was 12 grains, as against 36 grains. The inspector would require the maker's name, capacity, and in the case of a beam scale, its class, to be marked on the scale. He would check the knife edges for hardness, the agate bearings for the absence of grooves, check that the balance ball was secure, see that the pans swung freely and require that the lead plug was clean to receive the verification stamp.

Mr. Lound concludes his article by expressing the hope that he would get a good inspector. I am sure he did...every time.

Notes & Queries

NQ 75 COUNTERFLIT COIN DETECTOR

Query from Dennis Vorley

Yesterday, I acquired an interesting numismatic item with a weight connection - hence this letter to seek your comments. It is in the form of a brass plate with slots for the following coins: Sovereign, Half-sovereign, Crown, Half-crown, Florin, Shilling, Sixpence, Fourpence, and Threepence. Immediately below each slot is a brass arm grooved and open at its end to receive the coin and allow it to roll out. At the end of the arm is a counterpoise which, presumably, would prevent the acceptance of the coin if it were underweight. The brass plate has no screw holes for fixing to a counter. I would, as usual, value your comments on this matter.

REPLY

from the Editor

Your new acquisition is certainly a rarity - I know of only a few examples in museums and private collections. It is, indeed, a counterfeit coin detector, and your type has no screw holes because it was fitted into

slots in a small mahogany box which stood on top of the counter. There was, also, a version which did have screw holes for mounting over a hole in the counter top, below which, was a drawer for the money. In use, any false coin, or grossly worn coin, would not pass through the device. It would either be too large to go through the slot, or too light to depress the weight-checking beam. The design was patented by George Davis, in 1853, No.1979, but they were still shown in the Avery catalogue of 1916. An illustration of a complete detector can be seen in EQM (Page 269, Fig 3).

Review

THE AMERICAN WEIGH

Coin-operated person scales originated in Europe, but were taken up in America with enthusiasm, in the late 1880's. Their use became a popular pastime, encouraged by gambling scales and fortune-telling scales. A few entrepreneurs investing in chains of 'penny-scales', soon found they had a multi-million dollar business, and early Industrial Designers were engaged to re-style the scales in the latest fashion. The story of this extraordinary aspect of American life is outlined in a most attractive booklet published by the Taft Museum, Cincinnati.

This beautifully presented, glossy publication has 27 full-page colour illustrations of characterful penny-scales from the huge collection of Christopher Steele. Each machine is briefly described; makers names and patent numbers are given, and even the designer's name is mentioned, in some cases. Seven of the scales are very darkly coloured and, unfortunately, they do not show well against the black background, leaving the reader frustrated and curious about their true shape, but the other illustrations seductively compensate for this minor shortcoming. Perhaps enthusiasts would have liked more information about the type of weighing mechanism used, and close-up photos of the fascinating interiors visible in the windows on some machines.

The American Weigh is a most welcome addition to scale literature, filling a long-standing gap - the weighing of people. Highly recommended.

THE AMERICAN WEIGH - Vintage Penny Weighing Scales from the Collection of Christopher Steele, published by the Taft Museum, Cincinnati, Ohio, USA, in 1984. Available from the museum, or from ISASC Publications. 60 pages.

OLD AS METHUSELAH

Hans Jenemann has pointed out that Agicola's dates, given on page 665 as 1454 - 1555, should have been 1495 - 1555.

Precision Balance 8

HANS JENEMANN

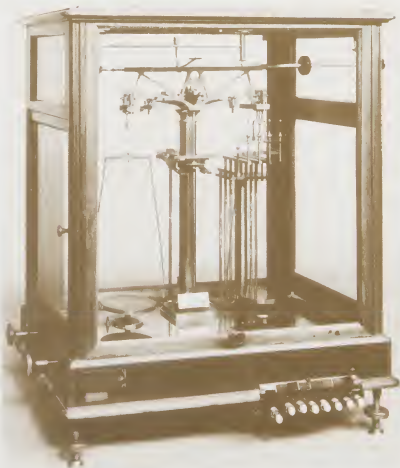


FIG 1.

This analytical balance was made by A.Rueprecht & Son, in Vienna c.1890. The gold-plated lattice beam has a length, from knife to knife, of 180mm (7.1"). The straight upper member of the beam is graduated, reading from the centre '0' to 100 on each arm. Thus, by using a 10mg rider weight, it is possible to weigh from 0.1 to 10mg without putting loose weights on the pan. (compare with Precision Balance 2, EQM p563). The rider weight is positioned on the beam by the rod projecting from the right side of the case, and the maximum capacity of the beam is 200g.

When weighing with analytical balances, great problems were encountered using the, so-called, fractional weights, below 1g. They were difficult to handle, being so small, and the frequent opening and closing of the doors of the case disturbed the balance and allowed dust to enter. So, makers of precision balances endeavoured, at an early date, to install systems for the mechanical loading of weights.

Rueprecht made a mechanism for all the difficult small weights, from 10 to 990mg, on the balance shown here, Fig 1, for which he obtained Deutsches Reichs Patent (D.R.P.) No.43846, in 1888.* By using two 10mg, one 20mg and one 50mg weight, it was possible to get every combination from 10 to 90mg in 10mg steps. Similarly, two 100mg, one 200mg and one 500mg weight made

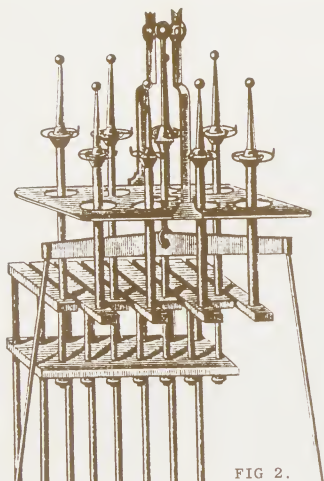


FIG 2.

possible all the 100mg decades from 100 to 900mg. These weights were operated by a 'keyboard' with eight push-buttons, shown at the bottom of the case in Fig 1.

Rueprecht's keyboard is composed, for each of the eight weights, of a system of two levers (below the baseplate of the case), Fig 4, and a vertical rod which carries a little wire ring weight which rests on a swelling in the rod, Fig 2. The rods can be seen inside the case supporting the weights above a horizontal brass plate fixed to the pan hanger suspended from the right end of the beam. When one of the push-buttons is pressed down, the levers gently lower the vertical rod so that the weight is deposited on the brass plate. Each of the eight buttons is marked with the mass of the weight, so it is possible to calculate the sum of the weights in use.

Beside this fascinating mechanism, the Rueprecht balance has more unusual features; firstly, a sensitivity device used as a 'pre-balance' to quickly determine the approximate weight of the load in the range less than 10g. It has two brass plates, one of about 4g and the other about 40g, which are supported above swellings on the upper part of the pointer, by a lever system, Fig 5. When the left rear knob is turned, the levers lower first the 4g plate and then the 40g plate onto the swellings, Figs 5a,b,c. With both plates on the pointer, sensitivity is reduced to 1/1000 of normal. Consequently, the load can be weighed quickly, but approximately, by functioning as an inclination balance. The weight is indicated on the little white scale at the base of the pillar.

Also visible, on the left side of the case, is a small opening for the pneumatic pump (now missing). It consisted of a rubber bulb and tube (like that used for testing blood-pressure). When the bulb was pressed, air was blown through pipes to jets below the scale pans. Thus, when the balance came to rest, it could be moved again, by the air, to test the position of the pointer by the deflection method. Alternatively, it was possible to blow air under the moving balance to damp the movement (compare with Precision Balance 7, EQM p700). ➤

* The first maker to construct a device whereby ALL the weights could be loaded from outside the case, was Paul Bunge, in Hamburg, 1874. A balance of this type was shown at the International Exhibition of Scientific Instruments in London, in 1876.

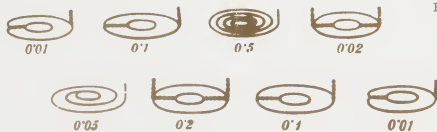


FIG 3. Wire ring weights.

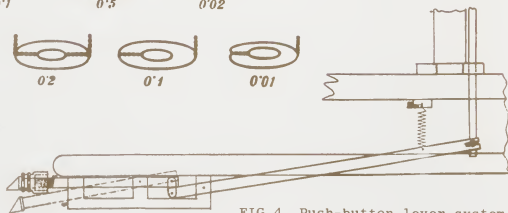


FIG 4. Push-button lever system.

The front knob, on the left side of the case was for operating the arrestment and release of the beam by a parallel mechanism. (compare with Precision Balance 5, EQM p642 - which shows a 'circular mechanism').

The firm of A.Rueprecht & Son, of Vienna, was founded by Albert Ruprecht in 1858 (the name later changed to Rueprecht with two e's). Albert was born in 1833, in Halle an der Saale (like Paul Bunge, and Paul Stuckrath of Berlin), and died in Vienna, in 1913. His son, also called Albert, and his grandson Alfred, both continued the firm, but Alfred's son became an opera singer. When the author visited their workshops, in 1978, the firm had just closed down, thus bringing to an end the once famous precision engineering industry of Vienna.



FIGS 5a,b,c. Sequence in lowering weights onto the pointer for quick weighing. a) both weights suspended. b) Small weight deposited on the pointer. c) Both weights deposited on the pointer.

Early Platform Scales

Part 3

MICHAEL CRAWFORTH

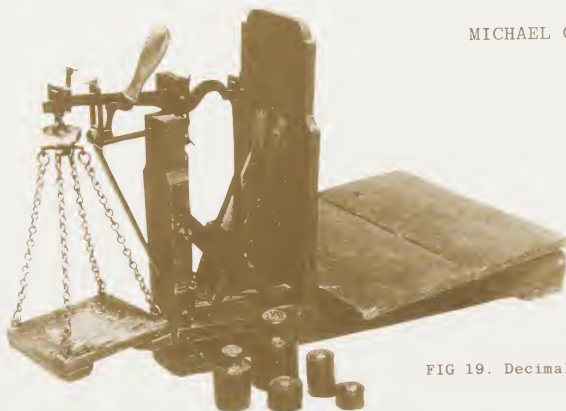


FIG 19. Decimal scale c1890.

In Continental Europe, the platform scale was also in use in the 18th century, but apparently not until some years after Wyatt's first machine was built. Haeberle (10) refers to the weighbridge made by Johann Emanuel Bondeli, of Berne in Switzerland, and mentioned in the Hanovershen Magazin Band III, of 1765. No details of this machine are given.

Europeans, too, were busy devising improvements. In 1803, Charles Merlin of Strasbourg, applied for a French patent for methods of constraining the platform during loading, in order to protect the bearings from damage. Some years later, Friedrich Alois Quintenz, of Gegenbach in the German Schwarzwald, was asked by the Baden government to manufacture weighbridges for waggons, and to erect them on main roads. Quintenz had studied widely under the Benedictine monks, and became a priest and a professor of mathematics and philosophy (science). Evidently, he was also of an inventive mind, and, like Wyatt, he had tried to design a spinning machine. Whilst involved in the manufacture of weighbridges, Quintenz became interested in designing a portable platform scale which could exploit the proportional ratio to particular advantage. This became his 'decimal scale' which had a ratio of 10 to 1, and which was especially appropriate to the new French metric system. With a good eye for the commercial prospects, Quintenz moved to Strasbourg, in France, where he obtained the help and financial backing of his friend, the banker, Frederic Rollé. In 1822, Quintenz obtained a patent for his decimal scale, but tragically, he died of pneumonia only nine weeks later. Rolle took a new partner, Jean-Baptiste Schwilgué, a professor and weights and measures inspector, and established the well-known firm of Rolle & Schwilgué. They continued to make and improve Quintenz' design of platform scale.

The lever arrangement used by Quintenz, was similar to Eayre's design, in that it used two overlapping 'A'-shaped levers, but there the similarity ended. Quintenz chose a three-point suspension for the platform, which was roughly triangular, Fig 20. Two of the points were knife edges bearing upon the lower lever, in the normal way. The third was at the narrow end of the platform suspended by a rod from the end of the weighbeam. A similar hanging suspension was used for the end of the lower lever. The great improvement over Eayre's design, was this suspension which applied the load to the weighbeam without rubbing the knives on the bearings. Proportional weights were placed in a hanging pan. One criticism of the Quintenz design was the poorer stability of the triangular platform for large loads, compared with the rectangular, four-point suspension system.

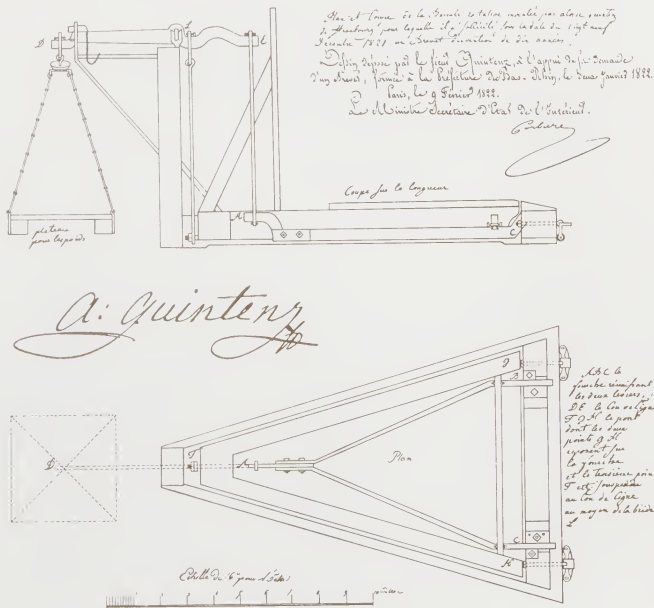


FIG 20. Extract from Quintenz' patent, 1822.

E. & T. FAIRBANKS.
WEIGHING SCALE.

Patented June 13, 1831.

Fig. 1.

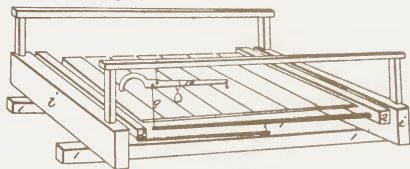


FIG 21. Extract from Fairbanks' U.S. patent.

In America, misleading claims have been made for the invention of the platform scale in 1830, by Thaddeus Fairbanks, notably by Bacon, in *Scale Journal*, (3), by Morgan (14), and by other authors. The account of this 'invention', given in *E. & T. Fairbanks Pioneers in Industry*, gives the impression that at the time Thaddeus thought of his idea, the platform was, for him, a new concept in weighing. However, in 1833, when he and his brother Erastus obtained a British patent, they were fully aware that they had NOT made a prime invention. Perhaps they had, by this time, seen the steelyard and platform scale described in *Encyclopaedia Britannica*, which had a good sale in the Eastern States of America. Fairbank's patent was merely for "*Certain Improvements in the Construction of Weighing Macines*", and at the end of the patent, these improvements were summarised as:

"The construction of that part of the machine denominated the rocker, with the manner of arranging the levers and attaching them to the rockers; the manner of constructing the joints with their knife edges, and of allowing that part of the joints called the standard to vibrate, for the purpose herein-before described; the use of the adjustable weight upon any part of the beam of the balance for the purpose described."*

Fairbanks' lever arrangement comprised two wooden planks, parallel to the ends of the platform, which rocked on a longitudinal axis. Projecting from the planks were straight levers parallel to the sides of the platform. These levers were connected at their free ends, and one was extended for attachment to a steelyard, Fig 21. This design forms a UU layout. A weakness of the design lay in its reliance on torsional stiffness of the planks, which, because they were of wood, was not very high. The weight referred to in the patent, was for adjustment of the scale to zero with the beam horizontal, this and the other parts of the steelyard are shown in Fig 26. In England, even this claim to originality was dismissed by scalemakers on the grounds that it had all been done before - circumstances which eventually led to the extraordinary court case of *Little vs Kitchen*.

* This seems to have been an error. The standards were used to enable the LEVERS to vibrate - the technical term for rocking to and fro until equilibrium is reached.

George Little was a distant relative of the Fairbanks brothers, and he, along with three of their friends, Henry Bellows, Truman Stevens and George B.Redington, were frequent visitors to Britain. In the belief that it was necessary to be present in England in order to apply for a patent, the Fairbanks brothers appointed George Little and their friends to act on their behalf when next in England. These four subsequently commissioned a British patent agent, Miles Berry, to make the application. Thus, the patent, No.6479, of 1833, was in the name of Miles Berry, but assigned to Little, Bellows, Stevens and Redington. Nowhere in the patent is the name of Fairbanks mentioned, but the connection with Little is clearly stated in a letter written by Henry Fairbanks describing his father's affairs.

It seems that Little was the most active of the partners, and it was he who travelled all over England trying to promote interest in the patent among scalemakers. However, none of them were interested. A similar blank was drawn in Continental Europe, where Hermann Schroder, another agent, was bent upon the same errand.

While Little was dejectedly waiting in Liverpool for a boat to take him back to America, his hotel proprietor suggested that he should show the patent to Henry Pooley. Little approached Pooley, who at that time, in 1835, had a thriving engineering and foundry business. Although interested in the patent, Pooley was reluctant to buy the British rights, because for him, scales were a new venture. After some negotiation, they settled on a licence and royalty arrangement, and Pooley immediately started to modify Fairbanks' design to make it suitable for manufacture from cast iron. This was not only because he was an iron founder, but also to use materials more suited to the British climate than the timber originally used by Fairbanks. Pooley soon obtained an important contract to supply the new railways with weighbridges, and the business got off to a good start.

In America, the Fairbanks brothers continued to develop their design, and in a series of patents, in 1837, they modified the lever arrangement to the torsionally more rigid YV and UV systems which had been in use in England since the 18th century. Perhaps this was a consequence of their association with Henry Pooley, or perhaps it was a logical development brought about by necessity.

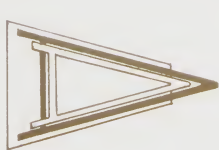


FIG 22. Quintenz' AA levers.



FIG 23. Fairbanks' UU layout.

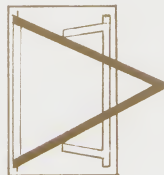


FIG 24. Fairbanks' UV levers.

Some years later, Pooley discovered that platform weighbridges were being built by Richard Kitchen of the nearby town of Warrington. When he complained about this, Pooley received the reply from Kitchen that he, and other English scalemakers, had been making platform scales and using the same ideas as Fairbanks, long before the patent was obtained. Kitchen said that he had examined the patent during Little's tour, and had found nothing new or novel in it.

Apparently, Henry Pooley thought it necessary to try and make the patent more enforceable, for, in February 1843, he made a successful application to alter the patent on the grounds that it had been incorrectly described. The entire summary, quoted above, was cancelled, and the following was substituted:

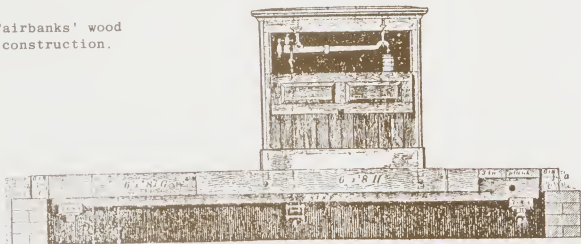
"First, the arrangement and form of the rockers and levers, with the construction and use of a diagonal, long. or principal lever."
"Second, the peculiar construction of the parts called the joints, including the position of the knife edges, and the method of preserving the relative ranges and distances of the fulcrums and sustaining joints by means of oscillating props or suspended links."
"Third, the peculiar form of steelyard and manner of suspension of the steelyard herein-before described, and the method of keeping the equilibrium of the machine by the use of a weight moveable along a screw fixed upon any part of the balance or steelyard."
"Fourth, the construction and manner of using the platform as described, having a frame or timber sills underneath the platform, with suitable bearings resting on the sustaining points upon the levers."
"Fifth, the use of a lever placed over the head of the machine, and connected with the levers below the platform, for the purpose of relieving the centres and other working parts from the strain or wear at all times, except while actually weighing goods."

The amended patent had no effect upon Pooley's competitors, who continued to make platform scales, as before. Pooley, faced with this continued infringement of the patent, as he saw it, decided to initiate a lawsuit, and the case of Little vs Kitchen began, in the Winter of 1843. The defendant brought forward many scalemakers who gave sworn affidavits about making platform scales long before 1833. Notable was the evidence of Thomas Shilton, who stated that his father, William Shilton of Baddersley Ensor in Warwickshire, had first applied the steelyard to platform scales many years previously. Kitchen's case was overwhelmingly proved, and the Berry-Little-Fairbanks' patent was not upheld.

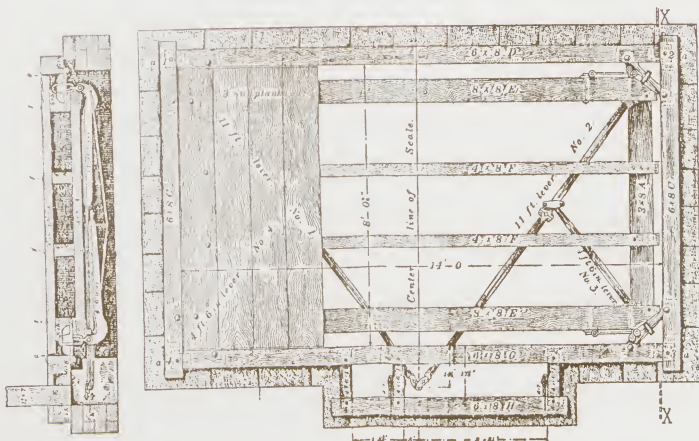
Today, an examination of surviving 18th century English platform scales, and of the few records so far discovered, shows that virtually all the details of Faibanks' design were, indeed, featured in the machines of the 18th and early 19th century; four-point suspension of the platform; second order levers; transfer arms or levers; vibrating beams; connecting rods to low or high-mounted weighbeams; steelyards; and knife edges. Yet,

the Fairbanks' design became widely known and had a good reputation. It is difficult, now, to assess the reason for this success, but the answer may well be found in the convenience of construction and use of Fairbanks' platform scales which brought together most of the good features in one design. In England there was, also, the tremendous enthusiasm and publicity for everything connected with the railways - that great new technology of the 19th century, which affected the lives of so many people. Pooley's exclusive contract with the railways spread the Fairbanks name throughout Britain and its colonies. Other manufacturers, too, took up patent rights and W. & T. Avery of Birmingham, and R. Simpson of Manchester both listed

FIG 25. Fairbanks' wood and iron construction.



American Weighbridge (by Fairbanks)



Fairbanks platform scales in catalogues and advertisements. After the lawsuit, all reference to Fairbanks seems to have been dropped from maker's literature, but the name continued to be talked about in the way that Hoover and Singer became synonymous with vacuum cleaner and sewing machine, in England.

In 1847, Pooley took out patent No.11754 for his own improvements to platform scales, which included multiple steelyards and relieving gear among the eight modifications described. His lever design bore a much closer relationship to the derivations of Wyatt's arrangement, than to Fairbanks' original patent. Thereafter, Pooley manufactured platform scales with the mark "POOLEY'S PATENT".

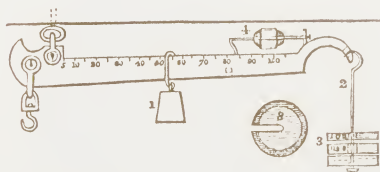


FIG 26. The steelyard from Fairbanks' improved patent of 1832.

1. Common poise.
2. Rod to support the weights.
3. Weights.
4. Adjusting weight.

Thus, Fairbanks' design was not the original idea with which he has been credited, and which, perhaps, he thought it was at the time of his inspiration. This, however, is merely a historical point. Of far more practical importance is the great influence that Thaddeus Fairbanks' ideas for the construction of platform scales had upon the whole of America's home and export markets. In England, too, his ideas influenced design for the home markets and the colonies, but there were many English manufacturers whose scales predated Fairbanks' patent. These earlier ideas provided a long established, widespread, and mature tradition of platform scale construction. It is these lever systems which solved the problem of cart weighing and the weighing of heavy goods, and which led to the convenient elimination of ropes and chains.

The main credit for this success must go to John Wyatt, who, modest and unassuming, received little personal reward for his invention. It was his inspiration which revolutionised the weighing of heavy goods and waggons at a most crucial time in the Industrial Revolution.

ACKNOWLEDGEMENTS

This work would have been a mere skeleton without the research notes of W.A.Benton which were kindly made available to me by the Avery Historical Museum. My thanks go also, to the Science Museum for permission to show their Haas person scale, and to G.L'E.Turner who supplied the photographs of it; and to the British Waterways Museum for permission to illustrate their barge weigher.

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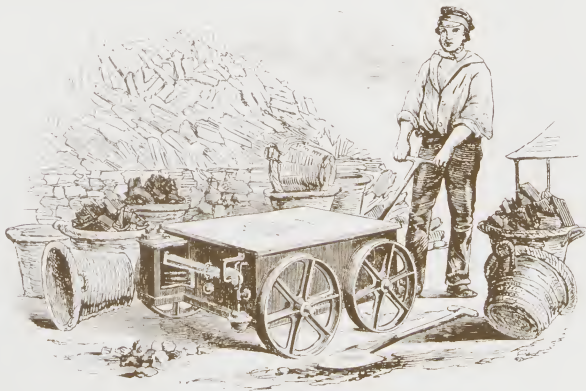


Fig 27. A mobile 'Coke depot weighing machine' illustrated in the Pooley & Son catalogue of c1877. There is no pillar or other projection above the platform to prevent large objects overlapping the edges. Size of platform, 30 x 30 inches (760 x 760mm) Capacity 5 cwt.

Wardmote Inquest

W.H.PYNE (1808)



The figure in this Plate represents an officer of the Wardmote Inquest in the dress of his office; each ward has its inquest, the members of which are chosen from among the most respectable inhabitants, and the establishment is peculiar to the city of London. We read of their existence as early as 1383, in a statute of Richard II, who punished all night-walkers and disorderly persons, by confining them in a prison called the tun. The power of this inquest is extensive, as the regulating several branches of the police falls to their department, one material part of which is the assaying of weights and measures.

Among the many wholesome laws made by our countrymen of old, for the suppression of fraud, stand conspicuous those which were formed for regulating the standard of weights and measures; but though the utmost vigilance was exerted by the officers appointed to superintend this department of the police, it appears the propensity to cheating was so great among traders, that severe penalties were enacted, and punishments multiplied to oblige them to be honest. The goldsmith's company were permitted the privilege of assaying precious metals when wrought into ornaments, utensils etc; the leathersellers that of inspecting the quality of hides; the aleconners the trying of wines and other liquors; and various trades and callings had their inspectors; all these officers being governed by a code of regulations, highly creditable to the wisdom of the legislators and magistrates of these early times.

Formerly, most of the necessary articles of consumption were vended in public markets; the hurry and confusion attendant upon such numerous assemblies must have exposed people to great impositions; to prevent which, public weighing beams were erected in different parts of the metropolis, which were attended by officers called weigh-masters, at whose beam all commodities sold might be re-weighed, by which frauds were not only discovered, but the commission of many, also, prevented. We find, as early as Edward II, that a petition was preferred to that monarch, for leave to erect a weighing beam in the churchyard of St.Mary, Wollchurch, (near Stock's Market) for the purpose of taking tronage, or tonnage upon wool, and for weighing all other commodities by the city weigh-master, who was to see justice done between buyer and seller. Before the salutary laws of Charles II were enacted for regulating the markets, the standard for each diocese was held by the bishop, who appointed a priest to preside over the market of his town, empowering him to see that justice was done to each party, to assay weights and measures, and to fine those who trespassed against the law; hence arose the custom and title of Clerk of the Market.

By a statute of Henry VII "*...the mayors and other head officers in market towns shall, twice a year or oftener, cause all weights and measures within the same to be brought before them, and examined; and such as they find defective, to be broken and burnt; and the offender shall forfeit to the mayor or other officer, for the first time, six shillings and eight pence; for the second time, thirteen and fourpence; and the third time, twenty shillings, and be set on the pillory.*" The penalties relating to this heinous offence have been mitigated during the present reign, though the immorality of the act calls for a severe punishment.

The Editor is indebted to Emil Cohn Jnr. for submitting this interesting account of early weights and measures control and its illustration of the officers pursuing their duty. The picture of a large beam scale is very accurate, showing a classic English swan-neck beam. The article is an extract from 'The Costume of Great Britain' by W.H.Pyne, London, William Miller, 1808.

Sets of Weights

MICHAEL CRAWFORTH



FIG 1.

Dealers, and some collectors, spend many months trying to assemble what they call a 'set' of weights. All too often, the result is a conglomeration of vaguely similar shapes, different colours of brass and unmatched stamps. Most discerning collectors, even beginners, will spot the disparity after a brief inspection. The natural caution we all acquire from such experiences may, at times, work against us, for the truth is that some genuine sets of weights did not, originally, match in all respects.

Ideally, a 'set' should be a group of weights of a standardised range of denomination, which were sold together for use together. As such, they should have the same style of numerals and letters for the denomination and the maker's mark (if any), and the same verification mark. However, the date stamp might be different because all denominations were not stamped on the same visit by the inspector (see EQM p44). Dates of inspection might differ, too, as weights were often stamped only if some adjustment had been made.

The older the weights are, the more likely that they were made by one manufacturer as a matching set. In more recent times, especially in the 20th century, suppliers of shop scales often obtained weights of different denominations from various manufacturers, regardless of whether they were matched in style, colour or marks. Thus, a set supplied to the shopkeeper could include several minor variations of weight design. In use, weights were often lost, especially those of small denomination, and, as John Lound says, "Many a housewife has found the odd 4oz or 8oz weight in her bag of potatoes when she arrived home after shopping! - and the replacements could be very different from the originals."



FIG 2.

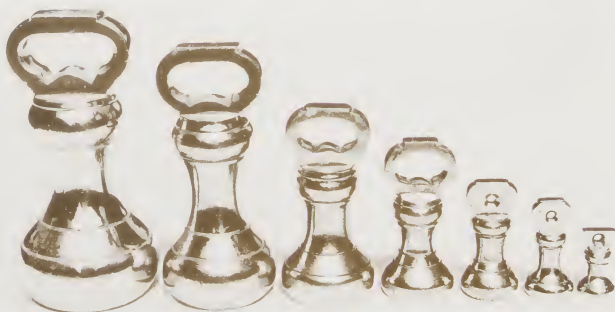


FIG 3.



FIG 4.



FIG 5.

Some sets were intentionally made with different designs. Inspector's globe weights and cylindrical weights changed from handles to knobs, and then to flat weights, as the denominations became smaller, Fig 5. Iron weights for trade use were permitted down to 4oz, by the Act of 1907, but from 2oz to $\frac{1}{2}$ oz, or less, they had to be brass. The same Act limited the use of flat round weights to the range 4lb to $\frac{1}{2}$ dram. Thus, a 'set' could comprise 56 lb to 7 lb iron bell, ring, or bar weights, 4 lb to 4 oz iron flat round weights, and 2 oz to $\frac{1}{2}$ oz brass flat round weights. Such a mixture is shown in Fig 1. Weights in drams were usually supplied as an extra for use by chemists.

Brass bell weights, 'white brass' bell weights, or the rare stainless steel bell weights, had matching shapes down to 1 lb. Below that denomination, the handle design was often simplified. Some retained the external profile but had a plain round hole drilled through the handle, others had a simple flat topped 'trapezoidal' handle with a drilled hole, and some had no hole at all. Genuine sets are known to have had all three shapes, as shown in Co-operative Society catalogue of 1925, Fig 2. Although this may distress the aesthetic sensibility of many collectors, the reasons for the differing shapes were strictly commercial, it being easier and cheaper to cast the simpler shapes.



FIG 6.



FIG 7.

Sets of weights, especially those sold for trade use, rarely covered the whole range of permitted denomination. They were limited to those sizes which were useful to the purchaser, commonly 7 lb to $\frac{1}{4}$ oz, or 4 lb to $\frac{1}{4}$ oz for shopkeepers with roberval counter scales or beam scales, and 7 lb to 1 lb, or 4 lb to 1 lb, for use with semi self-indicating scales, where the subdivisions of 1 lb were shown on the graduated chart by the pointer of the pendulum or spring mechanism. Very, very few sets ranged from 56 lb to $\frac{1}{4}$ oz, and they were typically used in factories, like woollen mills. A set with such a wide range should be examined very carefully to see if any additions have been made.

It is not always clear, by inspection, what is missing from an incomplete set of weights. Guidance can be obtained from the following tables of permitted denominations from the Weights and Measures regulations arising from the Act of 1878. Weights which do not fall into these categories (e.g. 3 lb, 8 lb etc) which have verification marks, date from before the Act of 1878. If they do not have verification marks, they could date from before or after 1878, because the regulations only applied to weights used for trade purposes. Weights of unusual size or design were often made for kitchen scales, or for use in factories.

The author thanks John Lound for his professional advice and guidance in compiling this article.



FIG 8.

AVOIRDUPOIS		TROY			
56 lb	100 lb	500 oz	0.5 oz	4000 gn	0.5 gn
28 lb	20 lb	400 oz	0.4 oz	2000 gn	0.3 gn
14 lb	10 lb	200 oz	0.3 oz	1000 gn	0.2 gn
7 lb	5 lb	100 oz	0.2 oz	500 gn	0.1 gn
4 lb		50 oz	0.1 oz	300 gn	0.05 gn
2 lb		40 oz	0.05 oz	200 gn	0.03 gn
1 lb		30 oz	0.04 oz	100 gn	0.02 gn
8 oz		20 oz	0.03 oz	50 gn	0.01 gn
4 oz		10 oz	0.02 oz	30 gn	0.005 gn
2 oz		5 oz	0.01 oz	20 gn	0.003 gn
1 oz		4 oz	0.005 oz	10 gn	0.002 gn
$\frac{1}{2}$ oz	8 dr	3 oz	0.004 oz	5 gn	0.001 gn
$\frac{1}{4}$ oz	4 dr	2 oz	0.003 oz	3 gn	
	2 dr	1 oz	0.002 oz	2 gn	
	1 dr		0.001 oz	1 gn	
	$\frac{1}{2}$ dr				

APOTHECARY		METRIC		
10 oz		10 kg	500 gram	5 decigram
8 oz		6 kg	200 gram	2 decigram
6 oz		5 kg	200 gram	2 decigram
4 oz		4 kg	100 gram	1 decigram
2 oz		3 kg	50 gram	5 centigram
1 oz		2 kg	20 gram	2 centigram
$\frac{1}{2}$ oz	4 drachm	20 kg	20 gram	2 centigram
	2 drachm	10 kg	10 gram	1 centigram
	1 drachm	5 kg	5 gram	5 milligram
	2 scruple	2 kg	2 gram	2 milligram
$1\frac{1}{2}$ scruple	$\frac{1}{2}$ drachm	2 kg	2 gram	2 milligram
1 scruple		1 kg	1 gram	1 milligram
$\frac{1}{2}$ scruple				

Table of approved denominations. Board of Trade, 1878.

FIG 1. Inverted roberval counter scales with a set of iron bar weights of 28,14,7 lb, round weights of 4,2,1, $\frac{1}{2}$, $\frac{1}{4}$ lb, and round brass weights of 2,1, $\frac{1}{2}$, $\frac{1}{4}$ oz.

FIG 2. Bell weights from the C.W.S. catalogue of 1933.

FIG 3. Stainless steel bell weights - compare handle shapes with Fig 2.

FIG 4. A made-up set of brass 'bottle' weights, 14 lb - $\frac{1}{2}$ oz.

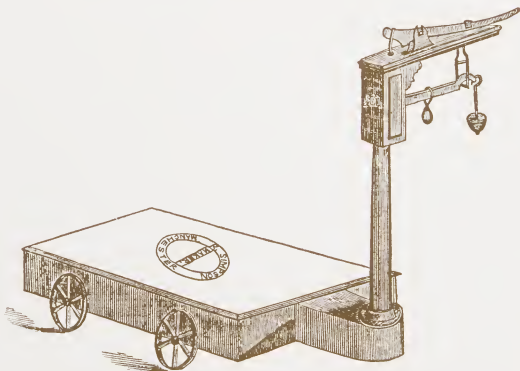
FIG 5. Inspector's globe weights. Note the intentional change of handle shape, and the change to flat weights for the small denominations.

FIG 6. A matched set of brass bell weights. Only one, 4oz, is replaced.

FIG 7. Inspector's cylindrical weights with ring handles and knobs.

FIG 8. Inspector's cylindrical weights with tee handles and knobs.

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